Reamed Intramedullary Nailing Affects Trauma-Induced Coagulopathy Based on Thrombelastography

Prism Schneider, MD, PhD, FRCSC[1]*; Elizabeth Davis, BS*[2]*; Matthew Galpin, RC*[3]*; Robert Hudson, BS*[4]*; Patrick Mitcham, BS*[2]*; Mark Prasarn, MD*[4]*; Joshua Gary, MD*[5]
[1]*University of Calgary, Calgary, Alberta, CANADA;*
[2]*University of Texas Health Science Center at Houston, Houston, Texas, USA;*
[3]*UTHSC Orthopaedic Trauma, Houston, Texas, USA;*
[4]*University of Texas at Houston, Houston, Texas, USA;*
[5]*UT Houston Department of Orthopaedic Surgery, Houston, Texas, USA*

Background/Purpose: Reamed intramedullary nails (rIMNs) are the standard of care for adult diaphyseal tibia and femur fractures. However, reaming stimulates the immune system and raises proinflammatory cytokines. Patients suffering major trauma often experience trauma-induced coagulopathy (TIC), which correlates with morbidity and mortality; however, it is unknown whether intramedullary reaming and the release of inflammatory factors exacerbate TIC in orthopaedic trauma patients. Rapid thrombelastography (r-TEG) is a technology that evaluates the clotting function of whole blood and elevated maximal amplitude (mA) is associated with increased risk for venous thromboembolic events (VTEs). We hypothesized that TIC will be exacerbated in patients treated with rIMN fixation for lower extremity fractures, as demonstrated by increasing mA from r-TEG values following reaming.

Methods: This is a prospective cohort study of patients aged 18-75 years with femur fractures (AO-OTA 31, 32 and 33 A, B, C) or isolated tibia fractures (AO-OTA 41-A, 42-A, B, C, and 43-A) amenable to treatment with rIMN fixation. Exclusion criteria were pathologic fracture, preinjury anticoagulation therapy, previous history of VTEs, active malignancy, burns >20% body surface area, and pregnancy. r-TEG measures were taken on arrival to the emergency department (arrival r-TEG), 1 hour prereaming (pre r-TEG), 1 hour postreaming (post r-TEG), and 24 hours postreaming (24-post r-TEG). The primary outcome measure was the 24-hour postoperative mA values from the r-TEG analysis. Secondary outcome measures included admission r-TEG, 1-hour preoperative r-TEG, 1-hour postoperative r-TEG, and inhospital VTE. All r-TEG specimens were analyzed using a TEG thrombelastograph 5000 (Hemoscope Corporation), using our institutional standardized protocol. Statistical comparisons between groups were performed using the Wilcoxon rank-sum test.

Results: 29 patients were enrolled (n = 19 femur fractures, n = 10 tibia fractures), including 14 females and 15 males, with the most common mechanisms of injury being motor vehicle collisions (n = 14) and motorcycle collisions (n = 5). There were no significant differences between the femur and tibia fracture groups for age (P = 0.61), body mass index (BMI) (P = 0.35), ISS (P = 0.14), arrival pH (P = 0.42), lactate (P = 0.48), heart rate (P = 0.52), or systolic blood pressure (P = 0.55), therefore the data for all patients treated with rIMN were pooled. The mean age was 41.1 (±16.9) years, mean BMI was 28.3 (±8.0), and mean ISS was 14.5 (±9.7). Mean reaming time for femurs was 11.1 (±6.5) minutes and mean tibial reaming time was 27.6 (±11.6) minutes (P = 0.008). All patients underwent definitive rIMN within 72 hours from arrival. The mean mA for the 24-hour postreaming r-TEG analysis of 68.7 (±5.2) was

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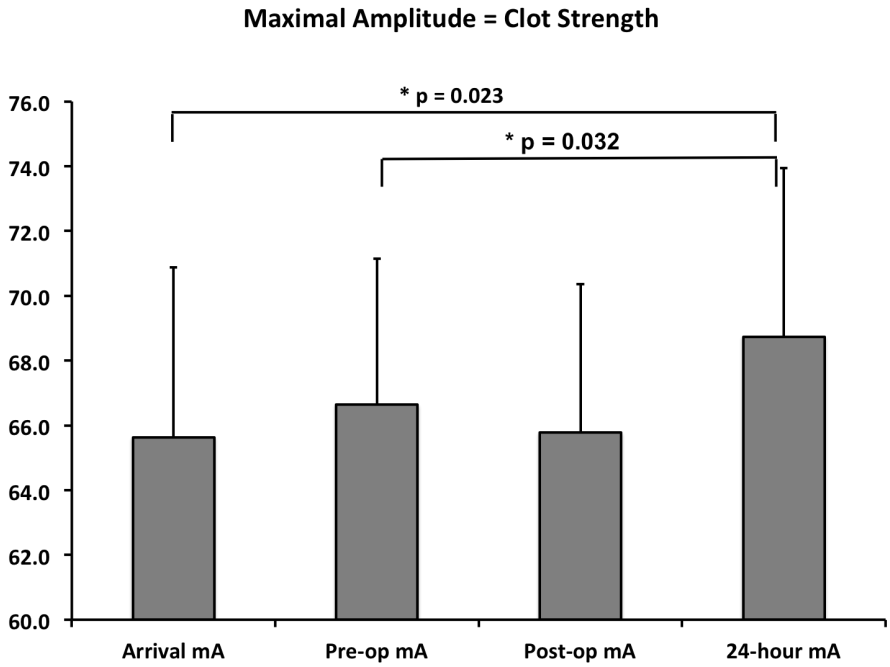
significantly higher when compared with the mean mA from the arrival r-TEG of 65.6 (±5.3) (P = 0.023). Similarly, the mean mA was 66.6 (±4.5) from the pre r-TEG and was significantly increased compared with the mean mA from the 24-post r-TEG (P = 0.032) (Fig. 1).



Conclusion: In this small prospective cohort group, there was an increase from both arrival and prereaming maximal amplitude, using r-TEG analysis, to the 24-hour postreaming mA, indicating increased coagulopathy in patients with diaphyseal femur and tibia fractures requiring treatment with rIMN. Future work will continue to investigate mechanisms and treatments to help prevent of the sequelae of trauma-induced coagulopathy.