

Factors Affecting Early Antibiotic Delivery in Open Tibial Shaft Fractures

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Abstract : Introduction: The incidence of infection in open tibial shaft injuries varies depending on the severity of the injury, with rates ranging from 1.8% for Gustilo-Anderson type I to 42.9% for type IIIB fractures. The timely administration of antibiotics upon presentation to the emergency department (ED) is an essential component of fracture management, and evidence indicates that prompt delivery of antibiotics is associated with improved outcomes. The objective of this study is to identify factors that contribute to the expedient administration of antibiotics. Methods: This is a retrospective study of open tibial shaft fractures at an academic Level I trauma center. Current Procedural Terminology (CPT) codes identified all patients treated for open tibial shaft fractures between 2015 and 2021. Open fractures were identified by reviewing ED and provider notes, and with ballistic fractures were considered open. Chart reviews were performed to extract demographics, fracture characteristics, postoperative outcomes, time to operative room, time to antibiotic order, and delivery. Univariate statistical analysis compared patients who received early antibiotics (EA), which were delivered within one hour of ED presentation, and those who received late antibiotics (LA), which were delivered outside of one hour of ED presentation. A multivariate analysis was performed to investigate patient, fracture, and transport/ED characteristics contributing to faster delivery of antibiotics. The multivariate analysis included the dependent variables: ballistic fracture, activation of Delta Trauma, Gustilo-Anderson (Type III vs. Type I and II), AO-OTA Classification (Type C vs. Type A and B), arrival between 7 am and 11 pm, and arrival via Emergency Medical Services (EMS) or walk-in. Results: Seventy ED patients with open tibial shaft fractures were identified. Of these, 39 patients (55.7%) received EA, while 31 patients (44.3%) received LA. Univariate analysis shows that the arrival via EMS as opposed to walk-in (97.4% vs. 74.2%, respectively, $p = 0.01$) and activation of Delta Trauma (89.7% vs. 51.6%, respectively, $p < 0.001$) was significantly higher in the EA group vs. the LA group. Additionally, EA cases had significantly shorter intervals between the antibiotic order and delivery when compared to LA cases (0.02 hours vs. 0.35 hours, $p = 0.007$). No other significant differences were found in terms of postoperative outcomes or fracture characteristics. Multivariate analysis shows that a Delta Trauma Response, arrival via EMS, and presentation between 7 am and 11 pm were independent predictors of a shorter time to antibiotic administration (Odds Ratio = 11.9, 30.7, and 5.4, $p = 0.001$, 0.016, and 0.013, respectively). Discussion: Earlier antibiotic delivery is associated with arrival to the ED between 7 am and 11 pm, arrival via EMS, and a coordinated Delta Trauma activation. Our findings indicate that in cases where administering antibiotics is critical to achieving positive outcomes, it is advisable to employ a coordinated Delta Trauma response. Hospital personnel should be attentive to the rapid administration of antibiotics to patients with open fractures who arrive via walk-in or during late-night hours.

Keywords : antibiotics, emergency department, fracture management, open tibial shaft fractures, orthopaedic surgery, time to or, trauma fractures

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