

Risk Factors and Outcomes Related to Gram-Negative Fracture-Related Infections

Elizabeth M. Benson, MS; Robert W. Rutz, MD; Austin Atkins; Karen Joyce Carter; Evan G. Gross; Matthew T. Yeager, BA; Clay A. Spitler, MD; Joseph Johnson, MD

Purpose: This study aims to elucidate risk factors for gram-negative (GN) fracture-related infections (FRIs) and the impact of GN status in treatment and outcomes.

Methods: A retrospective study was performed at a Level I trauma center that included extremity FRIs over a 7- year period (2013-2020). Information on demographics, comorbidities, injury characteristics, surgical characteristics, infection presentation characteristics, treatment parameters, and postoperative complications were recorded. Patients were placed in cohorts based upon pathogen causing FRI. In the 2-group analysis, patients were separated into GN or non-GN cohorts. In the 3-group analysis, patients were separated into GN only, gram-positive (GP) only, or polymicrobial.

Results: 299 patients met inclusion criteria; 76 (25%) had a GN microbe present in their FRI. Between cohorts age, race, and body mass index (BMI) displayed no significant differences. Male gender was a risk factor for GN FRI ($P = 0.020$). Social comorbidities, including smoking, IV drug use, and alcohol use, did not vary significantly between cohorts. Of the medical comorbidities, diabetes mellitus, chronic obstructive lung disease, and chronic kidney disease were insignificant between cohorts; however, cardiovascular disease (CVD) was protective of a GN FRI ($P = 0.028$). Of patients with GN FRIs, 67% were polytraumatized compared to 50% of non-GN FRIs ($P = 0.014$). Risk factors for developing GN FRI included external fixation ($P = 0.014$), skin grafting ($P = 0.045$), and flap coverage ($P = 0.011$). Complications more likely to be seen in GN FRIs included sinus tract formation ($P = 0.013$) and amputation ($P = 0.023$). Post-hoc analysis of the statistically significant categorical variables in our 3-group analysis was performed and demonstrated polymicrobial infections behave similarly to GN FRIs.

Conclusion: Risk factors for GN FRIs include male sex, CVD, polytrauma, external fixation, and flap coverage or skin graft. GN FRIs are associated with poorer postoperative outcomes, including sinus tract development and amputation, and require more operative trips for infection clearance. Polymicrobial FRIs clinically behave more similarly to GN than GP FRIs. These risk factors, associated outcomes, and clinical patterns can help delineate risk for certain patients preoperatively and aid clinician discussions with patients who sustain FRIs regarding their clinical course and treatment prognosis.