Paper - Annual Meeting

Paper Session: General Interest

Serologic and Nutritional Assessment of Nonunion: A Multicenter Investigation

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Purpose: This multicenter study investigated the association of nutrition and serologic studies with fracture nonunion.

Methods: From January 1, 2011 to December 31, 2017, consecutive individuals surgically treated for nonunion were identified from 7 centers via search of CPT codes. Femoral neck, scaphoid, talus, and fifth metatarsal fractures were excluded. We assessed medical history, nonunion type, and metabolic, endocrine, inflammatory, nutrition, and hematologic serum tests. Statistical analysis included $\chi 2$, Student t test, and multiple logistic regression. Significance was set at $P < 0.05$.

Results: 640 individuals met inclusion criteria; 57% were male. The mean age was 49 years. Nonunion sites included 225 tibias (35.2%), 164 femurs (25.6%), 130 humeri (20.3%), and other less frequent bones. Types of nonunion included 316 atrophic (49.4%), 140 oligotrophic (21.9%), 113 infected (17.7%), and 71 hypertrophic (11.1%). Smoking (36%, $P < 0.01$), diabetes mellitus (19%, $P < 0.01$), and average body mass index (BMI) (29.9, standard deviation [SD] = 7.6; $P < 0.01$) were higher than population norms. Medications included nonsteroidal anti-inflammatory drugs (NSAIDs) (35.2%), psychotropics (25.5%), statins (21.3%), antacids (20.6%), antiepileptics (10.6%), and steroids (4.5%). 82.4% had at least 1 serologic abnormality. Increased mean platelet volume (49.9%), erythrocyte sedimentation rate (ESR) (37.2%), C-reactive protein (CRP) (21.0%), parathyroid hormone (PTH) (24.5%), red cell distribution width (RDW) (20.0%), and thyroid-stimulating hormone (TSH) (65.0%) were seen. Decreased prealbumin (34.8%), hemoglobin (29.2%), absolute lymphocyte (24.4%) and neutrophil counts (15.1%), vitamin D (22.3%), transferrin (20%), albumin (19.4%), and calcium (25.3%) were seen. Abnormal values that associated solely with infected nonunion were increased ESR, CRP, PTH, and RDW and decreased mean corpuscular hemoglobin (MCH) and albumin ($P < 0.05$). Decreased calcium was seen in both infected and oligotrophic, increased hemoglobin was seen in atrophic, increased hematocrit was seen in both atrophic and hypertrophic, and increased platelets were seen in both hypertrophic and infected ($P < 0.05$). Abnormal values of TSH, vitamin D, white blood-cell count (WBC), mean corpuscular volume (MCV), mean platelet volume (MPV), absolute neutrophil count (ANC), and absolute lymphocyte count (ALC) did not differ among nonunion types.

Conclusion: Malnutrition and serologic abnormalities are common in nonunion. In contrast to prior literature, vitamin D and calcium are often normal in nonunion. High RDW and low albumin are associated with malnutrition and should be evaluated alongside current routine serology and corrected. Other nutritional markers including TSH, vitamin D, and ALC may be abnormal in nonunion but they are not predictive in differentiating infected from aseptic nonunion. Infected nonunions are highly associated with increased ESR, CRP, PTH, and RDW and low MCH and albumin. A scoring system to predict infected nonunion will be presented.