Inflammatory Laboratory Markers in Periprosthetic Hip Fractures

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Abstract: The purpose of this study was to determine the prevalence of increased inflammatory laboratory markers in patients with periprosthetic fractures. We also studied the likelihood of the elevation of these values in predicting deep prosthetic joint infection. From 2000 to 2006, 204 patients with periprosthetic hip fractures were treated at our institution. Patients had white blood cell, erythrocyte sedimentation rate, and C-reactive protein obtained on initial evaluation; these were then compared with subsequent hip aspiration, surgical pathology, and deep cultures obtained at the time of revision surgery. A true infection was diagnosed in 11.6%. White blood cell count was increased in 16.2%, erythrocyte sedimentation rate increased in 33.3%, and C-reactive protein increased in 50.5%. The positive elaborate predictive value for these markers for infection was poor (18%, 21%, and 29%, respectively). These findings suggest that increased inflammatory laboratory values in patients with periprosthetic fracture are not good indicators for deep periprosthetic infection and do not necessarily warrant additional evaluations before definitive surgical treatment. **Key words:** periprosthetic, hip, fracture.

Periprosthetic hip fractures are an increasingly common clinical problem given the prevalence of total hip arthroplasty and increasing years of clinical follow-up. When a patient with a prosthetic joint presents with acute onset pain, the orthopedic surgeon should exclude the possibility of a deep prosthetic joint infection. One common method of assessing the likelihood of a concurrent deep prosthetic joint infection is by measuring inflammatory laboratory values, such as the white blood cell (WBC) count, percentage polymorphonuclear cell on differential analysis, erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP). These laboratory tests are not specific for prosthetic joint infection. Although an increase in these serologic markers has been demonstrated in acute fractures and after surgery [1-4], the manner in which these inflammatory markers are affected in periprosthetic fractures is not known. Moreover, we are not aware of any data assessing the predictive value of infection with these markers in the presence of periprosthetic fractures.

The purpose of the present study was to determine the prevalence of increased inflammatory laboratory values in patients with periprosthetic fractures as well as correlate them with intraoperative findings and culture results. The review of periprosthetic hip fracture data from a single institutional database was conducted to determine the prevalence of increased serologic inflammatory markers in the setting of periprosthetic hip fractures and the positive predictive value of those increased values in predicting deep joint infection in the setting of periprosthetic fracture.

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Materials and Methods

Demographics

After the institutional review board authorization, using our institutional clinical patient database and total joint registry, we identified 204 patients who had received surgical treatment of a postindex arthroplasty fracture located around their hip prosthesis between 2000 and 2006. The mean age of the patients was 70 years. There were 111 women and 93 men. The right hip was injured in 105 cases and the left hip in 99 cases. We categorized those femoral fractures according to the Vancouver classification proposed by Duncan and Masri [5]. This classification incorporates the location of the fracture, the fixation of the stem, and the quality of the femoral bone stock. Type A fractures are those situated in the trochanteric region. Type B fractures are those located around or just distal to the stem. Type C fractures are those located below the stem. Type A fractures are subclassified into A_G where fractures involve greater trochanter and type A_L where fractures involve lesser trochanter. Type B fractures are subclassified into B1 if the implant is stable, B2 if the implant is loose, and B3 if the implant is loose and bone stock around the stem is inadequate. In this series, there were 12 type A_G, 1 type A_L, 6 type B1, 105 type B2, 35 type B3, and 1 type C fractures. Thirty-two patients who received treatment of stem fracture and 12 patients for acetabular fracture with their total hip arthroplasty were all included in the data analysis.

For each patient included in the data analysis, WBC with differential analysis, ESR, and CRP were obtained in the emergency department as a routine on initial evaluation after trauma. Objective measurement of infection as final aspiration and/or surgical pathology was also obtained from included patients. Patients who did not have initial laboratory tests, final aspiration, surgical pathology, or clinical outcome data available were excluded from this study. All other identifiable causes that could increase inflammatory markers, such as urinary tract infection, pneumonia, chronic bronchitis, and rheumatoid arthritis, were studied and recorded.

Definition of Infection

A hip was considered to be infected if 2 or more samples of the intraoperative tissue or the intra-articular aspiration were positive for growth on bacterial culture.

Laboratory Markers

The method of analysis used by Greidanus et al [6] for the "erythrocyte sedimentation rate/CRP level to diagnose infection before knee revision" was used for this study. The normal value for WBC count is 4500 to 10 000 cells/mL. Erythrocyte sedimentation rate is a hematologic test that measures the length of fall in millimeters of a column of erythrocytes in a given interval. The normal value is less than 20 mm/h. C-reactive protein is a globulin synthesized in the liver with normal value of less than 0.5 mg/L. For the analysis, we used predetermined abnormal levels based on previously published criteria for the evaluation of infection located on total hip arthroplasty site. As a result, the positive result for the inflammatory laboratory test corresponded to its abnormal value. White blood cell abnormal values were 10.5×10^9C/L or greater, ESR abnormal values were 30 mm/h or greater, and CRP abnormal values were 10 mg/L or greater [6-9].

Statistical Analysis

All results were analyzed and reported via the electronic clinical medical record. Statistical analysis was performed to determine for each marker, true positive, true negative, false positive, and false negative in regard to infection. The prevalence of increase for each inflammatory marker in the presence of periprosthetic fracture, the average level of increase, as well as the predictive value of these laboratory tests in predicting culture-positive and/or surgical/pathology-positive deep joint infection were reported. Sensitivity and specificity were also calculated for each marker. These were done for the overall population and for each of the following subcategories: true periprosthetic hip fracture, stem fracture, and acetabular fracture. Results were expressed as the percentages for categorical variables and the mean ± SD for continuous variables, unless otherwise stated. The accuracy of the diagnostic test is equivalent to the area under the curve (AUC) of the respective receiver operating characteristic (ROC) curve [6]. The analysis was conducted using SAS version 8.2 (SAS Inc, Cary, NC).

Results

True infection (positive culture) was diagnosed in 21 cases (11.6%) of the 204 fractures. Aspiration was done in 41 cases. Aspiration was done at the discretion of the surgeon. Often, it was not performed if surgery is going to be performed before results would be available. Results were positive in