Hematological Parameters Predicting Complications of Caustic Ingestion: A Retrospective Study

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**Purpose:** In addition to chemical burn of the alimentary tract, caustic ingestion can cause severe complications including esophageal perforation, airway edema, esophageal stricture, and death. Hematological parameters have been reported to be useful inflammatory markers predicting prognoses in various clinical situations where oxidative stress is increased. We hypothesized that hematological parameters might be useful for prediction of complications after caustic ingestion.

**Methods:** We performed a retrospective analysis of patients admitted to our Emergency Department after caustic ingestion. The numbers of leukocytes, neutrophils, lymphocytes, and monocytes, and the neutrophil-lymphocyte ratio were compared between uncomplicated and complicated patient groups. Receiver operating characteristic curve analysis was performed for parameters that differed between the two groups. Subgroup analysis was performed according to the substance ingested, thus acid or alkali.

**Results:** Thirty-seven patients were included in our study and eight had complications. Leukocyte, neutrophil counts, and the neutrophil-lymphocyte ratio of the complicated group were higher than those of the uncomplicated group.

**Conclusion:** Leukocyte counts, neutrophil counts, and the neutrophil-lymphocyte ratio might serve as useful predictors of complications after ingestion of caustic substances.

**Key Words:** Blood cell count, Caustics, Esophagus, Wounds and injuries

**Article Summary**

**What is already known in the previous study**
Hematological parameters have been reported to be useful inflammatory markers for predicting prognoses in various clinical situations where oxidative stress is increased.

**What is new in the current study**
Use of leukocyte counts, neutrophil counts, and/or the neutrophil-lymphocyte ratio can be helpful in predicting the presence of complications after caustic ingestion. Higher parameters were observed in complicated cases than in uncomplicated cases.

**Introduction**

More than 5000 cases of caustic ingestion are reported annually in the United States. Although common body areas exposed to caustic substances include the eyes, face, and extremities; fatalities have been reported only after caustic ingestion. About 80% of all caustic ingestions occur in children and are mainly accidental. Caustic ingestions in adults are usually associated with a suicidal intent and are frequently life-threatening. The mortality caused by caustic injury has been reported to be 14% after acid ingestion and 2% after alkali ingestion. Caustic ingestion first causes chemical burning of the alimentary tract and may trigger more serious com-
lications, such as esophageal perforation, airway edema caused by laryngeal chemical burns, systematic toxicity including hemodynamic instability, acidosis, and death⁶.

Early esophagogastroduodenoscopy (EGD) is crucial for the evaluation of caustic injury. Classification of esophageal burns via EGD is valuable prognostically, and is frequently employed for patient management in clinical settings⁷-⁹. However, early EGD is not always available, depending upon patient condition and the hospital visited. Apart from the initial chemical burn to the esophagus, oxidative stress and related inflammatory processes are known to further damage that tissue⁷). Several studies have evaluated laboratory data on inflammatory processes in efforts to define prognostic markers. Leukocyte counts reflected mortality from caustic ingestion in one study, but were not meaningfully correlated with occurrence of esophageal strictures in another work⁸,¹⁰. Leukocytosis, neutrophilia, monocytosis, and lymphocytopenia have been reported in the acute phase of clinical conditions in which oxidative stress is increased¹²-¹⁴. The neutrophil-lymphocyte ratio (NLR) is a useful prognostic marker in various diseases featuring inflammatory responses, such as sepsis, stroke, and appendicitis¹²-¹⁶. The complete blood count (CBC) is a widely used laboratory test that yields information on the hematological parameters mentioned above. However, to date, parameters other than leukocyte counts have not been investigated for their abilities to predict complications associated with caustic ingestion. Thus, we explored the utilities of hematological parameters in predicting complications of caustic ingestion.

Two independent investigators reviewed written and/or electronic medical records to retrieve demographic data; types of ingested caustics; CBCs obtained soon after admission to the ED; endoscopic findings within 24 h of ingestion; and complications such as esophageal perforation, mediastinitis, airway edema caused by laryngeal burns, esophageal stricture, or death. The counts of leukocytes, neutrophils, lymphocytes, and monocytes; and the NLR, were explored to determine if any feature was a useful predictive parameter. Grade 2B or higher burn in endoscopic finding was defined as a severe esophageal burn and, otherwise, a mild esophageal burn¹⁶. Included patients were divided into two groups in terms of the presence of complications: the uncomplicated and complicated groups. Hematological parameters predicting complications were the primary outcomes of the present study; such parameters were compared between the uncomplicated and complicated groups. As the type of caustic ingestion might influence the development of complications, subgroup analysis by acid or alkali ingestion was performed in the same manner.

An investigator blinded to the purpose of the study performed all data analysis, which employed SPSS version 21.0 (IBM corporation, Armonk, NY, USA) and MedCalc version 14.12.0. The demographic factors and hematological parameters of each group were subjected to descriptive analysis. Continuous data were expressed as means with standard deviation (SDs) if their distributions were normal, and as medians with interquartile ranges (IQRs) otherwise. Categorical data were expressed as numbers with percentages. After normality was analyzed, the demographic factors and hematological parameters of the two groups were compared. Student’s t-test was used to compare continuous data that were normally distributed and the Mann-Whitney U-test was employed to compare continuous data that lacked a normal distribution. Pearson’s chi-squared test and Fischer’s exact test were used to compare categorical data. Receiver operating characteristic (ROC) curves of hematological parameters that differed between the two groups were drawn to determine the statistical power of complication prediction. By using Youden’s J statistics, the optimal cut-off values of each parameter were calculated. A p value<0.05 was considered to indicate statistical significance.

Materials and Methods

The Institutional Ethics Committee of our hospital waived the requirement for ethical approval of our study. This retrospective work involved review of the medical records of patients who were admitted to a single academic hospital after ingestion of caustic materials from January 2001 to October 2014. All patients admitted to the Emergency Department (ED) after caustic ingestion were initially included, but patients for whom CBCs were not available within 24 h of caustic ingestion were subsequently excluded.