



# The relationship between clinical findings and esophageal injury severity in children with corrosive agent ingestion

## Koroziv madde içen çocuklarda klinik bulgular ile özofagus yaralanma şiddeti arasındaki ilişki

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### BACKGROUND

The aim of the study was to investigate the indicators of corrosive esophageal injury (EI) severity in children.

### METHODS

We retrospectively reviewed data from children who accidentally ingested corrosive substance and underwent endoscopic evaluation over a one-year period. A total of 134 consecutive children with corrosive agent ingestion who underwent diagnostic endoscopy (74 boys, 60 girls) were included in this study. Patients were divided into two groups as low-grade and high-grade EI. Statistical differences and predictive values of common signs and symptoms and white blood cell (WBC) count of patients with low- and high-grade EI were analyzed.

### RESULTS

The majority of patients (70%) were asymptomatic at the initial examination. We found that drooling saliva and oral lesions were significantly more frequent in high-grade injury ( $p<0.05$ ). Mean WBC count in the high-grade EI group was significantly higher than in the low-grade EI group ( $p=0.000$ ). Sensitivity, specificity and predictive values of clinical findings in children were analyzed; none of them was shown to be valuable for estimating EI severity. WBC count was sensitive, but it is not a good predictor.

### CONCLUSION

Our study demonstrated the relationship between clinical findings and corrosive EI severity in children with accidental corrosive ingestion, but direct visualization of the esophagus is required for definitive diagnosis.

**Key Words:** Corrosive; esophagus; predictive value.

### AMAÇ

Koroziv madde içen çocuklarda özofagus yaralanma şiddetinin göstergelerinin araştırılması amaçlandı.

### GEREÇ VE YÖNTEM

Bir yıllık süre içinde kazayla koroziv madde içen ve tanısal endoskopi yapılan çocukların bilgileri geriye dönük olarak incelendi. Koroziv madde içen ve endoskopi yapılan toplam 134 çocuk (74 erkek ve 60 kız) bu çalışmaya dahil edildi. Hastalar düşük ve yüksek dereceli özofagus yaralanması olarak iki gruba ayrıldı. Düşük ve yüksek derecede özofagus yaralanması saptanan hastalardaki sık görülen bulgu, belirti ve kan beyaz küre sayısının tahmin edici değerleri istatistiksel olarak analiz edildi.

### BULGULAR

İlk incelemede hastaların çoğunda (%70) belirti veya bulgu yoktu. Ağızdan salya akması ve ağız içi yaralar yüksek dereceli yaralanmalarda anlamlı olarak yüksek idi ( $p<0,05$ ). Ortalama beyaz küre sayısı, yüksek dereceli özofagus yaralanmalı grupta düşük dereceli yaralanmalı gruptan anlamlı olarak yüksek bulundu ( $p<0,05$ ). Klinik bulguların duyarlılığı, seçiciliği ve tahmin edici değerleri analiz edildiğinde, hiçbirinin özofagus yaralanmasını tahmin etmede değerli olmadığı bulundu. Ortalama beyaz küre sayısı duyarlı bulundu, ancak iyi bir gösterge olmadığı bulundu.

### SONUÇ

Çalışmamız kazayla koroziv içen çocuklarda klinik bulgular ile özofagus yaralanma şiddeti arasında ilişki olduğunu gösterdi, kesin tanı için özofagusun doğrudan gözlenmesi gerekmektedir.

**Anahtar Sözcükler:** Koroziv; özofagus; tahmin edici değer.

Accidental ingestion of corrosive products is still a common problem in children, especially in developing countries, and may lead to serious esophageal injury (EI). Because no certain clinical or laboratory test is available to indicate the severity of EI, it is accepted that a visual evaluation of the esophagus is mandated.<sup>[1]</sup> On the other hand, the necessity of routine endoscopy in these children with/without signs and symptoms remains controversial. Therefore, to prevent unnecessary endoscopy and hospitalization, many studies have focused on the correlation between the clinical characteristics and the severity of EI.<sup>[2-11]</sup>

The aim of the present retrospective study was to investigate the predictive value of clinical findings and WBC count in the estimation of EI severity in children after corrosive agent ingestion.

## MATERIALS AND METHODS

In this study, we reviewed consecutive pediatric patients who underwent diagnostic endoscopy for suspected ingestion of corrosive substance at our institution from June 2008 to June 2009. Patients with ingestion duration of more than 24 h were excluded from the study. Data were collected from patient charts, including their age and sex, nature of the corrosive substance (acid or basic), common signs and symptoms, white blood cell (WBC) counts, and endoscopic findings. The severity of EI was classified according to endoscopic appearance, according to Zargar,<sup>[12]</sup> into five grades as follows: grade 0 (negative finding), grade 1 (edema and hyperemia of the mucosa), grade 2 (non-circumferential [2a] or circumferential [2b] friability, hemorrhage, erosion, blisters, whitish membrane, exudates and superficial ulcer), and grade 3 (multiple ulcerations and areas of necrosis). Patients were divided into two groups as low-grade (grade 0, 1 and 2a lesions) and high-grade (grade 2b and 3 lesions) EI.

The associations between values of signs, symptoms and WBC count and the severity of EI were analyzed statistically. Data are presented as description of frequency, percentages, mean, and standard deviation

(SD). Correlations between clinical characteristics and groups were analyzed using chi-square or Student's t test if appropriate. A p value less than 0.05 was considered statistically significant. To determine the predictors for the estimation of EI, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of clinical findings and WBC count were calculated in data analysis. WBC up to  $10.5 \times 10^3/\mu\text{L}$  was considered as the upper limit of normal (the best cutoff point). Statistical analysis was performed using SPSS 11.0 for Windows.

## RESULTS

A total of 134 consecutive children with a corrosive ingestion who underwent diagnostic endoscopy were included in this study. Endoscopies revealed negative findings (grade 0) in 56 cases (42%), grade 1 in 17 cases (13%), grade 2a in 44 cases (33%), grade 2b in 15 cases (11%), and grade 3 in 2 cases (2%). The demographic properties, clinical characteristics and mean WBC count of patients according to groups are presented in Table 1. When analyzing clinical characteristics according to groups, there were no significant differences in age, sex or corrosive substance type between low-grade and high-grade injury groups ( $p > 0.05$ ). The most frequently ingested corrosive substance was basic product (85%). The majority of patients (70%) were asymptomatic at the initial examination. The most common sign was oral lesions (29%). The presence of vomiting and respiratory symptoms in children with low-grade EI was more frequent than in children with high-grade injury, but there was no statistically significant difference between groups ( $p > 0.05$ ). Drooling saliva and oral lesions were found significantly more in the high-grade injury group than in the low-grade group ( $p < 0.05$ ). The mean WBC counts of the high-grade EI group were significantly higher than of the low-grade EI group ( $p = 0.000$ ). In the follow-up period (3-15 months), an esophageal stricture developed in five children, and all of them had a high-grade injury.

The predictive values of initial symptoms and

**Table 1.** Demographic and clinical characteristics of patients with corrosive agent ingestion

	Low-grade esophageal injury (n=117; 87%)	High-grade esophageal injury (n=17; 13%)	Total (n=134; 100%)	p
Male/Female	65 (55%)/ 52 (45%)	9 (53%)/ 8 (47%)	74 (55%)/ 60 (45%)	.839
Age (y) (mean $\pm$ SD)	3.4 $\pm$ 2.4	3.7 $\pm$ 1.8	3.4 $\pm$ 2.3	.668
Acid/Basic	17 (15%)/100 (85%)	3 (18%)/ 14 (82%)	20 (15%)/ 114(85%)	.822
Vomiting	10 (9%)	4 (24%)	14 (10%)	.059
Drooling saliva	4 (3.5%)	8 (47%)	12 (9%)	.000
Respiratory symptom	2 (2%)	1 (6%)	3 (2%)	.277
Oral lesion	28 (24%)	11 (65%)	39 (29%)	.001
WBC count ( $\times 10^3/\mu\text{L}$ ) (mean $\pm$ SD)	10.9 $\pm$ 3.0	17.0 $\pm$ 4.9	11.7 $\pm$ 3.9	.000

**Table 2.** Sensitivity, specificity, positive predictive value, and negative predictive value for respiratory symptoms and WBC count

Value	Sensitivity	Specificity	PPV	NPV
Vomiting	0.23	0.91	0.28	0.89
Drooling saliva	0.47	0.96	0.66	0.92
Respiratory symptom	0.05	0.98	0.33	0.87
Oral lesion	0.64	0.76	0.28	0.93
WBC count (above $10.5 \times 10^3/\mu\text{L}$ )	0.93	0.39	0.18	0.97

mean WBC count are shown in Table 2. Although the presence of each of vomiting, drooling saliva, respiratory symptoms, and oral lesions was not determined a good predictor for severe lesions (Sensitivity 0.23, 0.47, 0.05, 0.64; PPV 0.28, 0.66, 0.33, 0.28, respectively), the absence of symptoms was associated with no or minimal lesions (Specificity 0.91, 0.96, 0.98, 0.76; NPV 0.89, 0.92, 0.87, 0.93, respectively). WBC count level above  $10.5 \times 10^3/\mu\text{L}$  was highly sensitive for severe lesions, but PPV was low.

### DISCUSSION

After accidental corrosive ingestion in children, depending on the type, concentration, and volume of the ingested substance, varying degrees of chemical EIs may occur. Patients generally need to be consulted to a specialist for endoscopic evaluation. In this situation, the physician faces a dilemma in deciding whether to perform an endoscopy, especially when signs and symptoms are absent. Most authors had advised routine endoscopic evaluation of all patients after presumed corrosive ingestion. In several recent studies, the indication for endoscopy has been discussed, especially in children who have no signs and symptoms. Crain et al.<sup>[11]</sup> investigated the correlation between the presence or absence of three serious signs and symptoms (vomiting, drooling and stridor) and the findings on subsequent esophagoscopy. They suggested that the presence of two or more signs or symptoms in patients with a history of caustic substance ingestion may be a reliable predictor of EI. Lamireau et al.<sup>[6]</sup> also investigated the relationship between clinical findings and EI in children after ingestion of a caustic agent. Although the authors confirmed that the absence of an oropharyngeal burn does not rule out the presence of severe esophagogastric lesions, they recommended that endoscopy for asymptomatic children living in developed countries is not required. Havanond et al.<sup>[7]</sup> developed a simple chart to simplify the equation

from the final step using symptoms, clinical findings and endoscopic characteristics. They demonstrated a strong correlation between drooling saliva and severe esophageal lesions. Betalli et al.<sup>[8]</sup> found that the risk of severe damage to the esophagus increases proportionally with the number of the signs and symptoms. On the other hand, they stated that the presence of only “minor” symptoms, such as oropharyngeal lesions and vomiting, does not rule out the presence of relevant injuries to the esophagus. Our study revealed that although there were no significant relationships between presence of vomiting and respiratory symptoms and severity of EI, an association was found between drooling saliva and oral lesion and high-grade EI.

When analyzing the predictive value of clinical features in our study, none of them was a good predictor for estimation of the severity of EI. Although the correlation of a lack of symptoms to a lack of injury cannot be applied to patients who intentionally ingest a caustic substance,<sup>[9]</sup> our study revealed that absence of clinical findings indicated no or low-grade EI. Similar results have been published in the literature. Table 3 summarizes the predictive values of clinical characteristics in three independent studies. Lamireu et al.<sup>[6]</sup> found that respiratory distress is highly predictive in severe EI. In the study of Betalli et al.,<sup>[8]</sup> it was demonstrated that “major symptoms”, i.e., vomiting, drooling, respiratory symptoms, and oral lesions, have low sensitivity, specificity and PPV in relation to 3rd-degree EI.

According to the literature, few studies have produced clear results in terms of the predictive value of laboratory tests for EI. Otcu et al.<sup>[1]</sup> investigated biochemical predictors of caustic ingestion and presence of complicating EI. They demonstrated that serum electrolytes and other biochemical parameters do not appear to be indicative of caustic substance ingestion and/or predictive of a caustic EI, whereas low serum

**Table 3.** Summary of predictor values according to three studies (Sensitivity/Specificity/PPV/NPV)

Study	Vomiting	Drooling saliva	Respiratory symptoms	Oral lesions
Lamireau et al. (2001) <sup>6</sup>	0.40/0.82/0.45/0.80	0.04/0.88/0.12/0.72	0.22/1.00/1.00/0.78	0.43/0.93/0.71/0.81
Betalli et al. (2008) <sup>8</sup>	0.42/0.19/0.23/0.91	0.63/0.21/0.29/0.95	0.11/0.05/0.67/0.89	0.74/0.38/0.20/0.95
Present study	0.29/0.97/0.62/0.89	0.47/0.96/0.66/0.92	0.05/0.98/0.33/0.87	0.64/0.76/0.28/0.93

pH level indicates the ingestion of alkaline products. A few studies have revealed a significant correlation between WBC count and EI. Havanond et al.<sup>[7]</sup> found that an increase in the WBC count is more likely to be associated with high-grade EI. Chen et al.<sup>[10]</sup> also found that leukocyte and C-reactive protein counts are useful in evaluating the severity of organ injury. In the present study, we demonstrated that elevation in WBC count is a sensitive marker of severe EI in children with corrosive ingestion. The relationship between WBC count and EI is unknown. One of the possible mechanisms for the increasing WBC count in corrosive EI is mobilization of the leukocyte marginal pool as an inflammatory response to the corrosive EI. Another potential mechanism for elevation in WBC level is its positive correlation with bacterial translocation and injury severity. Nevertheless, only few experimental studies have shown an infection in corrosive esophageal burns.<sup>[13,14]</sup>

In conclusion, the present study showed a relationship between the clinical characteristics and esophageal injury severity in children with corrosive substance ingestion. Although presence of drooling saliva, oral lesions and high WBC count were found significantly more frequent in children with high-grade injury, none of them was shown to be a good predictor. Our study appears to confirm earlier works that established a need for direct visualization of the esophagus. Nevertheless, especially in developing countries where endoscopy is not readily available, clinical features and WBC count can help estimate the degree of EI, and guide the management.

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