

Predictability of Esophageal Injury from Signs and Symptoms: A Study of Caustic Ingestion in 378 Children

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ABSTRACT. The accuracy of signs and symptoms as predictors of the presence and severity of esophageal injury was evaluated in 378 children admitted to three pediatric hospitals between 1970 and 1980. The signs and symptoms analyzed included nausea, vomiting, dysphagia, refusal to drink, abdominal pain, increased salivation, oropharyngeal burns, and abdominal tenderness. The severity of lesions found at esophagoscopy in 378 children was graded from grade 0, no lesion, to grade 3, perforation. Of the 298 patients demonstrating signs or symptoms, 243 (82%) had a grade 0 or 1 lesion, 55 (18%) had a grade 2 lesion, none had a grade 3 lesion, and five (2%) developed a stricture of the esophagus. Among the 80 patients without signs or symptoms, 70 (88%) had a grade 0 or 1 lesion, ten (12%) had a grade 2 lesion, none had a grade 3 lesion, and one (1%) developed a stricture of the esophagus. When individual signs or symptoms were correlated with the severity of esophageal lesion, vomiting (33%) followed by dysphagia (25%), excessive salivation (24%), and abdominal pain (24%) were most frequently associated with a grade 2 or 3 esophageal lesion. A similar percentage of a grade 0 or 1 (82% v 85%), a grade 2 (18% v 15%), and a grade 3 (0% v 0%) esophageal lesion followed the ingestion, respectively, of an alkali (324 patients) or an acid (54 patients). In six patients (2%) stricture occurred only following an alkali ingestion. These data demonstrate that signs and/or symptoms do not adequately predict the presence or severity of an esophageal lesion following the ingestion of a caustic substance. *Pediatrics* 1983;71:767-770; *caustic ingestion, esophageal burn, esophageal stricture, esophagoscopy*.

severe esophageal injury resulting in perforation or stricture. The prediction of the occurrence and severity of an esophageal and/or gastric lesion has been a major problem for the physician confronted with a caustic ingestion.

Several authors have noted that the absence of oropharyngeal lesions¹⁻³ or pharyngoesophageal symptoms⁴ does not exclude the presence of esophageal or gastric injury. Most clinicians have the impression that patients at risk of severe esophageal injury and subsequent stricture of the esophagus will demonstrate signs and/or symptoms following the ingestion of a caustic substance.⁵

We undertook this study to evaluate the correlation between signs and/or symptoms and the occurrence and severity of esophageal lesions in a pediatric population.

METHODS

All admissions to Sainte-Justine Hospital in Montreal, The Children's Hospital Medical Center in Boston, and The Hospital for Sick Children in Toronto were reviewed for patients with a diagnosis of caustic ingestion during the years 1970 through 1980. Only patients with a history of an acid or alkali ingestion who underwent esophagoscopy within 48 hours of ingestion were included. Patients who had ingested a bleach product or a product that could not be clearly identified were excluded.

The indications for esophagoscopy in Montreal differed from those in Boston and Toronto. All patients who came to the Emergency Room of Sainte-Justine Hospital with a history of a caustic ingestion were admitted and underwent esophagoscopy. At The Children's Hospital Medical Center and

The ingestion of caustic substances may induce

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The Hospital for Sick Children, decisions regarding hospitalization and esophagoscopy for patients seen in the emergency room were made on an individual basis by the attending physician. Consequently, the results from Montreal were analyzed separately.

The following signs and symptoms were evaluated: vomiting, excessive drooling, abdominal tenderness, oropharyngeal burns, dysphagia, nausea, refusal to drink, and abdominal pain. The presence and severity of esophageal lesions as determined at esophagoscopy were classified following an adaptation of the method of Hawkins et al⁶: grade 0, absence of esophageal injury; grade 1, burn limited to the mucosa characterized by the presence of edema and/or erythema; grade 2, burn penetrating beyond the mucosa characterized by the presence of ulceration and/or whitish membrane; and grade 3, presence of perforation.

To evaluate the correlation between signs and/or symptoms and the presence and severity of esophageal lesions, patients were divided in two groups according to the presence (symptomatic) or absence (asymptomatic) of signs and/or symptoms. Also evaluated was the relationship between each specific sign or symptom as well as the type of product and the presence and severity of esophageal injury. All statistical analyses were performed using the χ^2 test.

RESULTS

During the years 1970 to 1980, 600 patients were admitted to the study hospitals with a diagnosis of caustic ingestion: 378 patients met the criteria for inclusion in the study; 222 patients were excluded because (a) they had ingested a bleach-containing product (44 patients), (b) the substance could not be precisely identified (25 patients), (c) esophageal involvement was evaluated only by barium swallow (126 patients), or (d) esophagoscopy was performed three to nine days after the ingestion (27 patients).

Of the 378 patients, 236 (62%) were male and 142 (38%) were female. Age distribution ranged from 9 months to 13 years with 79% of the patients aged 12 to 35 months. Of the 378 study patients, 324 (86%) ingested an alkali, and 54 (14%) ingested an acid. The involved products are listed in Table 1.

The relationship between the presence or absence of signs and/or symptoms and the occurrence and severity of esophageal burns, as well as subsequent stricture, is presented in Table 2. Differences in occurrence of esophageal lesions between the symptomatic and asymptomatic group were not significant. The same percentage of patients with grade 0, 1, 2, or 3 burns was found in patients with signs

TABLE 1. Involved in Caustic Ingestion

Products	No.	%
Alkali (N = 324)		
Lye	185	57
Ammonia	24	8
Tetrapotassium pyrophosphate	17	5
Electric dishwasher product	17	5
Others	81	25
Acid (N = 54)		
Swimming pool cleaner	18	34
Toilet bowl cleaner	6	11
Battery acid	5	9
Others	25	46

TABLE 2. Severity of Esophageal Lesion in Patients With or Without Signs and/or Symptoms*

Esophageal Lesion	Signs and/or Symptoms			
	Present (N = 298)		Absent (N = 80)	
	No.	%	No.	%
Grade 0 or 1	243	82	70	88
Grade 2	55	18	10	12
Grade 3	0	0	0	0
Stricture	5	2	1	1

* P values were not significant.

and/or symptoms in the Montreal as in the Boston and Toronto group (Table 3).

There were 298 patients with signs or symptoms. The frequency of grades 2 and 3 esophageal burns in patients with specific signs or symptoms is shown in Table 4.

Grades 0, 1, 2, and 3 esophageal burns occurred with similar frequency following the ingestion of an acid or an alkali product, but stricture, which was rare, occurred only following an alkali ingestion (Table 5).

DISCUSSION

Prediction of the presence and severity of esophageal injury following the ingestion of a caustic substance is a major problem for the clinician. Several investigators have demonstrated that from 8% to 20% of the patients without oropharyngeal burn subsequently manifested esophageal burns.^{1,2} However, they did not document the severity of the esophageal lesion nor did they evaluate the predictability of esophageal injury based on the presence or absence of other signs or symptoms.

Our study demonstrated that the incidence of grade 0, 1, 2, or 3 esophageal injury was similar whether or not patients had signs and/or symptoms (Table 2). The selection of patients for esophagoscopy (Boston and Toronto), based on the presence or absence of signs or symptoms, did not result in better prediction of the presence or severity of the esophageal lesion when compared with a setting in

TABLE 3. Severity of Esophageal Lesion in Patients with Signs and/or Symptoms*

Esophageal Lesion	Hospital			
	Montreal (N = 270)		Boston and Toronto (N = 28)	
	No.	%	No.	%
Grade 0 or 1	220	81	23	82
Grade 2	50	19	5	18
Grade 3	0	0	0	0
Stricture	4	1	1	4

* P values were not significant.

TABLE 4. Frequency of Severe Esophageal Lesion in Patients with Specific Signs or Symptoms

Signs or Symptoms	Patients (N = 298)	Esophageal Lesions (Grades 2 and 3)	
		No. of Patients	%
Vomiting	67	22	33
Dysphagia	106	26	25
Excessive salivation	46	11	24
Abdominal or epigastric pain	21	5	24
Refusal to drink	20	4	20
Oropharyngeal burn	279	51	18

TABLE 5. Severity of Esophageal Lesion by Product*

Esophageal Lesion	Alkali (N = 324)		Acid (N = 54)	
	No.	%	No.	%
Grade 0 or 1	267	82	46	85
Grade 2	57	18	8	15
Grade 3	0	0	0	0
Stricture	6	2	0	0

* P values were not significant.

which all patients were subjected to esophagoscopy (Montreal) (Table 3). Although a higher percentage of severe esophageal burn (grade 2 or 3 lesions) was associated with the presence of specific signs or symptoms such as vomiting (33%), dysphagia (25%), excessive salivation (24%), and abdominal pain (24%), the majority of these patients (67% to 76%) demonstrated no involvement or only mild involvement of the esophagus (grade 0 or 1). These results demonstrate that the presence or absence of signs or symptoms cannot accurately predict the occurrence or severity of esophageal lesion.

The development of esophageal stricture is a major complication that may follow the ingestion of a caustic substance. Only 2% of the total group of patients developed esophageal stricture: five patients (1.7%) in the symptomatic group and one patient (1.2%) in the asymptomatic group. Thus, the presence of signs and symptoms did not identify the patient at risk of developing this complication. In agreement with the current literature, all but

one of the patients who developed a stricture had a grade 2 esophageal burn on esophagoscopy.⁷⁻⁹ The development of esophageal stricture following a negative esophagoscopy has been noted.¹⁰ Explanations have included the fact that the esophagoscopy was performed before the mucosal damage could be seen, or the lesion was missed due to stopping of esophagoscopy above the site of the severe injury. In our study, esophageal stricture was found only with the ingestion of an alkali product. However, severe esophageal burns (grade 2) were encountered with similar frequency following both acid and alkali ingestion (Table 5). Thus, acids, although more frequently associated with severe gastric injury,¹¹⁻¹³ may also produce significant esophageal lesions. The low incidence (2%) and relatively mild form of stricture (dilation was the only treatment required) encountered in our population may be attributable to a decrease in the strength of these products, introduction of safety cap, and a greater parental awareness of the intrinsic danger of these products.

This is a retrospective study and, as such, presents some limitations. First, as with all retrospective studies, inaccurate information may have existed in the record, and it is possible that some signs or symptoms were not recorded in the chart. However, only one of nine signs or symptoms was required to categorize a patient in the symptomatic group. Therefore, it is unlikely that a patient classified as asymptomatic was, in fact, symptomatic. Second, esophageal burns were classified according to objective findings as noted on the esophagoscopy report. These findings may have been inaccurate because precise evaluation of the depth of mucosal damage is difficult and extension of the esophagoscope beyond the point of the proximal lesion is not recommended; therefore, more severe distal lesions may have been missed. Esophagoscopy, however, remains superior to barium swallow in the evaluation of esophageal involvement.^{9,14,15}

SUMMARY

This study demonstrates that signs or symptoms cannot accurately predict the presence and severity of esophageal lesions and the development of esophageal stricture. Esophagoscopy appears to be the more accurate way to evaluate the involvement of the esophagus following the ingestion of a caustic substance.

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DEVELOPMENTAL DISORDERS

In order to test the hypothesis that rates of motor and perceptual deficits in children tend to increase with maternal age, 65 children aged 5 to 6 years born to mothers with a mean age of 39.4 years were compared with 55 age-matched children born to mothers with a mean age of 27.9 years. The hypothesis was supported in that fine-motor problems were five times more common among the children born to older mothers than among those born to younger mothers. Visuoperceptual dysfunction and attentional deficit signs also were much more common among the children of older mothers. The contribution of various associated factors to these results is discussed.

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