Acta Chirurgica Belgica

ISSN: 0001-5458 (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/tacb20

Clinico-epidemiological Study of Caustic Substance Ingestion Accidents in Children in Anatolia: The DROOL Score as a New Prognostic Tool

I. Uygun, B. Aydogdu, M.H. Okur, Y. Arayici, Y. Celik, H. Ozturk & S. Otcu

To cite this article: I. Uygun, B. Aydogdu, M.H. Okur, Y. Arayici, Y. Celik, H. Ozturk & S. Otcu (2012) Clinico-epidemiological Study of Caustic Substance Ingestion Accidents in Children in Anatolia: The DROOL Score as a New Prognostic Tool, Acta Chirurgica Belgica, 112:5, 346-354, DOI: 10.1080/00015458.2012.11680850

To link to this article: https://doi.org/10.1080/00015458.2012.11680850

Original papers

Acta Chir Belg, 2012, **112**, 346-354

Clinico-epidemiological Study of Caustic Substance Ingestion Accidents in Children in Anatolia : The DROOL Score as a New Prognostic Tool

I. Uygun[1], *B. Aydogdu*[1], *M. H. Okur*[1], *Y. Arayici*[1], *Y. Celik*[2], *H. Ozturk*[3], *S. Otcu*[1]

[1]Departments of Paediatric Surgery and [2]Biostatistics, Dicle University, Faculty of Medicine, Diyarbakir, Turkey ; [3]Department of Paediatric Surgery, Abant Izzet Baysal University, Faculty of Medicine, Bolu, Turkey.

Abstract. *Background :* To examine the clinico-epidemiological details of paediatric caustic substance ingestion (CSI) accidents in Turkey. To present the new DROOL Score (DS), which the authors developed based on the severity and duration of initial signs and symptoms (ISSs) to predict oesophageal stricture (OS) without endoscopy, and to present our management protocol based on immediate feeding, early detection, and oesophageal balloon dilatation (OBD) of OS with no barium study.

Methods : We prospectively reviewed the records of 202 children admitted with a history of CSI within 48 hours. Patient, parent, caustic substance, and accident characteristics were noted in detail. Patients were fed as soon as they could swallow saliva. Diagnoses of OS were made earlier *via* timely endoscopy (mean, 10-14 days after CSI) for patients with persistent dysphagia and OBD was started earlier. ISSs and DSs were analyzed. OS treatment results were compared between early (10-14 days) and late (≥ 21 days) dilatation patients who were referred for OBD by other hospitals.

Results : In total, 144 (71%) incidents occurred within the parents' home and 44 (22%) occurred at another individual's home. The caustic substances were frequently sold in non-original containers (68.8%). Most patients' parents had low incomes and were poorly educated. Ninety-six children had no ISSs, whereas 106 patients had ISSs. Seventeen symptomatic patients had persistent dysphagia after 10-14 days. Timely endoscopy was performed within 10-14 days for these patients only, and OS was diagnosed and successfully treated. DSs were significantly lower in patients with OS than those without ($p < 0.001$). A DS ≤ 4 was a significant predictor of OS (100% sensitivity, 96% specificity, 85% positive and 100% negative predictive values). Results were significantly more satisfactory in early ($n = 17$) than in late ($n = 6$) dilatation patients.

Conclusions : Paediatric CSI accidents might decrease if caustic substances were sold in the original child-proof containers. OS can be highly predicted by a simple DS instead of endoscopic grading, and can be diagnosed earlier (10-14 days) *via* endoscopy only in patients with persistent dysphagia, instead of a late barium study (≥ 21 days). OBD can then also be started earlier in these patients.

Abbreviations

BSS :	barium swallow study
CSI :	caustic substance ingestion
DS :	DROOL Score
ED :	early dilatation
ISS :	initial signs and symptoms
LD :	late dilatation
NPV :	negative predictive value
OBD :	oesophageal balloon dilatation
OGD :	oesophagogastroduodenoscopy
OS :	oesophageal stricture
PPV :	positive predictive value
TPN :	total parenteral nutrition

Introduction

Accidental caustic substance ingestion (CSI) is a serious, life-threatening problem despite legislation limiting the strength and availability to children of corrosive substances (1-5). In previous years, caustic soda from soap was the main cause of damage, but currently, commonly available household cleaning products, such as grease cleaners, lime scale removers, drain cleaners, and battery acid, are highly corrosive agents that are ingested accidentally. In particular, in developing countries as well as Turkey, these agents are sold generically and in opened bottles that can be easily accessed by children (2-6). Preventive medicine has not taken sufficient measures to decrease the incidence of such accidents. In Turkey, the number of children who have ingested a corrosive substance is very high compared with the numbers in more developed countries (2, 5-13).

CSI remains a difficult problem because of the uncertain relationship between the initial signs and symptoms (ISSs) and the degree of gastroesophageal injury (1, 14). An early oesophagogastroduodenoscopy (OGD) is the most effective method for assessing the gastroesophageal mucosa in children suffering from CSI (1, 4,

5, 14). However, the indications for an early OGD in these patients have been debated (4, 5, 15-18). No strict guidelines for OGD exist for children suffering from CSI. Recent studies have recommended that early OGD should be performed in symptomatic patients and in all cases of intentional ingestion, even if the patient is asymptomatic (1, 4, 15-18). Currently, early OGD is not regarded as necessary in all CSI cases (1, 4, 15-18). However, several authors have attempted to correlate ISSs with the degree of gastroesophageal injury (4, 5, 15-18). Betalli *et al.* (4) reported that the presence of three or more symptoms is an important predictor of severe oesophageal burns.

Different modalities have been used to treat CSI in children, such as ipecac, oral dilution, neutralizing agents, antibiotics, systemic corticosteroids, antacids, starvation, total parenteral nutrition (TPN), and nasogastric tubes. However, controversy about the optimal management strategy persists, and none of these strategies is effective (1-4, 7-13, 19).

Development of an oesophageal stricture (OS) is a major complication following CSI in children. An OS develops after CSI in 7-15% of patients (4, 6, 11). Oesophageal balloon dilatation (OBD) is the traditional treatment for OS ; however, OBD guidelines remain unclear.

The objectives of this study were to clinico-epidemiologically analyze CSI accidents to examine their causes in children in Turkey and to present the DROOL Score (DS), which the authors developed as a new prognostic scoring instrument based on ISSs to predict OS without endoscopic grading, as well as our CSI management protocol based on immediate feeding, early detection, and OS dilatation without a barium swallow study (BSS).

Materials and methods

We prospectively reviewed the medical records of 202 children who were admitted to Dicle University Hospital, Diyarbakir, Eastern Anatolia, or to Dumlupinar University Evliya Celebi Training and Research Hospital, Kutahya, Western Anatolia, between September 2004 and April 2011 with a history of CSI within 48 hours.

Patient age at presentation and gender, parents' socioeconomic and educational levels and age, detailed features of the caustic substance and container, and data such as intention, location, and time were noted and analyzed. Our CSI management protocol was conducted for each patient after obtaining a detailed history and a physical examination (Fig. 1). Patients were scored using the DS, which enables the easy calculation of ISS severity and duration, rather than by endoscopic grading (Fig. 2). All ISSs were noted and followed. No patient underwent routine early diagnostic OGD at the initial admission, and patients did not initially stop liquid oral nutrition if they tolerated it. Enteral liquid nutrition was started immediately after the clinical examination for patients who were able to swallow easily ; then, soft and solid food was started consecutively, as the patient could tolerate. Patients tolerating full oral feeding were discharged within 24 hours. TPN was not used for any patients. Only liquids or soft foods were administered to patients who could not tolerate solids. No patient underwent a subsequent BSS, but OGD was performed under general anaesthesia in patients with only persistent dysphagia and vomiting, using a flexible gastroscope (GIF-XP160 video gastroscope and GIF-XP20 fiber gastroscope ; Olympus, Hamburg, Germany), between days 10 and 14 on average. If the OGD revealed an OS, the first OBD was performed early during the same general anaesthesia, and the patient was included in the OBD program. These patients were assigned to the OS (+) and early (mean, 10-14 days) dilatation (ED) groups, and all others who had no OS were designated OS (-). In contrast, six children with OS were referred to us for OBD > 21 days after CSI by another hospital that performed classical CSI and OS management ; because this treatment was late according to our classification, these patients were assigned to the late dilatation (LD ; > 21 days) group. One child, who was admitted late with a gastric outlet obstruction and treated surgically after two unsuccessful pyloric balloon dilatations, was excluded from the study.

All OBD procedures were performed fluoroscopically under general anaesthesia with endotracheal intubation. The balloon (Controlled Radial Expansion fixed wire balloon dilator ; length, 8 cm ; Boston Scientific Corp., Galway, Ireland) size was increased to a 20-mm diameter during subsequent OBD sessions in all patients. The interval between OBD sessions changed from 2 to 3 weeks during the first few months based on patient complaints. Then, the OBD interval was regulated based on symptom severity and OS. Relief of dysphagia, weight gain, and an increase in the period between OBD sessions were accepted as indications of a good response to OBD. BSS and OGD were not performed routinely after the first OBD. Patients were followed annually, even in the absence of symptoms.

All ISSs and DSs were compared between the OS (+) and OS (-) groups, but predictive values were calculated only in symptomatic patients because asymptomatic cases included confounding variables. OBD outcomes were compared between the ED (10-14 days) and LD (> 21 days) groups.

Statistical Analysis

Continuous variables are presented as means and standard deviations. Discrete variables are presented as medians. Student's *t*-test was used to compare the means

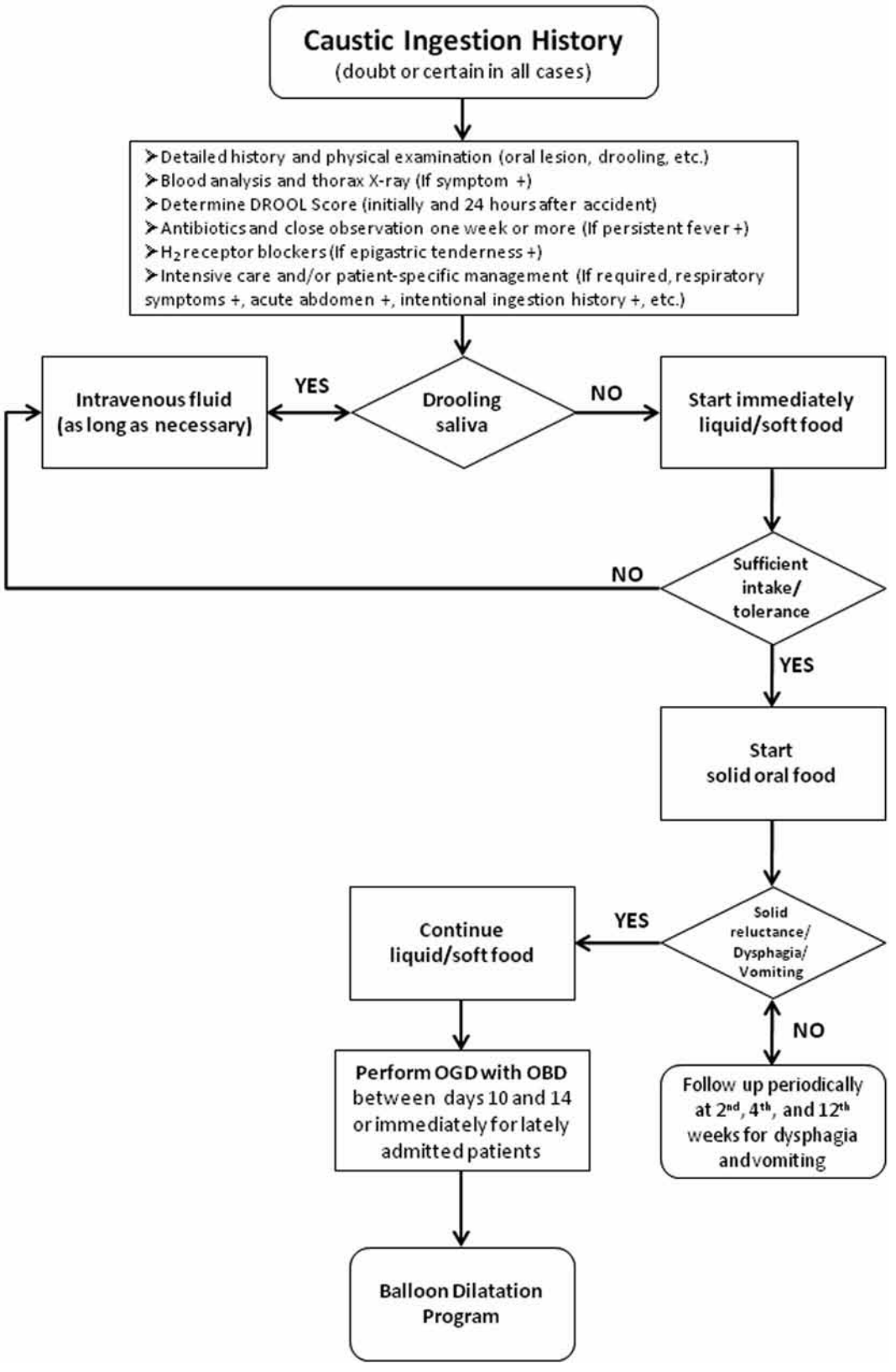

Fig. 1
Flowchart for managing caustic substance ingestion in children (OGD, oesophagogastroduodenoscopy ; OBD, oesophageal balloon dilatation).

THE DROOL CAUSTIC INGESTION SCORE

Component of acronym	Signs and Symptoms	Score of 0	Score of 1	Score of 2
Drooling	Drooling saliva	≥12 hours	<12 hours	No
Reluctance	Reluctance to eat or dysphagia or food intolerance	≥24 hours	<24 hours	No
Oropharynx	Oral and oropharyngeal burns	Severe lesions*	Oedema hyperaemi	No
Others	No. of other signs/symptoms: Persistent fever, hematemesis, abdominal tenderness, retrosternal pain and dyspnea	≥2	1	No
Leukocytosis	High white blood cell count	≥20,000	<20,000	No

* Friability, haemorrhage, erosion, blisters, whitish membrane, exudates, ulcer or necrosis

Fig. 2
The five criteria of The DROOL Score for the assessment of patients with caustic ingestion

of the early and late treatment groups. Yates' chi-squared test was used for the continuity correction to test the crosstab observations. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated for each parameter ; 2 × 2 tables were compared using the two-sided Fisher's exact test. Confounding variables were eliminated by excluding asymptomatic patients from the analyses to calculate the coefficients of sensitivity, specificity, PPV, and NPV and to compare OS (+) and OS (-) patients. Asymptomatic patients had predicted coefficients (sensitivity, specificity, PPV, NPV) higher than the actual values. Data were analyzed using SPSS (ver. 15.0 for Windows ; SPSS Inc., Chicago, IL, USA), and a p-value ≤ 0.05 was considered significant.

Results

In total, 202 patients with a history of CSI were analyzed (129 males, 63.9% ; 73 females, 36.1% ; age range, 1 month-17 years ; median age, 36 months). The average duration of follow-up was 48 months. The characteristics of the patients' parents are shown in Table I.

The features of the caustic substances are detailed in Table II. The ingested materials were bleach (n = 64, 31.7%) and grease (oven) cleaners (n = 62, 30.7%). The caustic substances were frequently sold in non-original containers (n = 139, 68.8%). All ingestions were accidental, and the intention was mostly to drink water (n = 165, 81.7%). The caustic substance had been given accidentally by another individual (mother, grandmother, or babysitter) in eight cases. Most of the children consumed the liquids straight (n = 198, 98%). Twenty-eight (13.9%) patients ingested a caustic substance directly from the original container, whereas the remainder ingested the substance from a non-original container (n = 168, 83.1%), such as a transparent plastic water bottle (n = 76, 37.6%) or a plastic carbonated-drink bottle (n = 47, 23.3%) ; 32 substances were placed in another non-original container by adults before the accidents. Many of the containers were small (≤ 500 cc ; n = 98, 48.5%).

The features of the CSI accidents are shown in Table III. The greatest number of accidents occurred in summer (n = 77, 38.1%) and spring (n = 64, 31.7%). A total of 144 (71%) incidents happened within the parents' home. Most accidents occurred in the kitchen (n = 104, 51.5%).

No ISS or OS was identified in 96/202 children. Thus, confounding variables were eliminated by excluding the asymptomatic (n = 96) patients from the analyses. Seventeen (8.4% of all cases) of the 106 symptomatic patients had persistent dysphagia after 10-14 days. Timely OGD was performed within 10-14 days for these patients only, and OS (n = 17) as a late complication (OS (+) group] was diagnosed. Other symptomatic patients (n = 89) had no OS or swallowing problems (OS (-) group]. OS was most often caused by grease cleaners (n = 14, 82.4%) and caustic substances sold in non-original containers (n = 14, 82.4%). The distribution of ISSs in the symptomatic patients and the prevalence of OS are shown in Table IV. Drooling saliva, reluctance to eat, and persistent fever were significantly higher in the OS (+) group than in the OS (-) group (p < 0.001). Both drooling time and leukocyte count were significantly higher (p < 0.001 and p = 0.003), whereas DSs were significantly lower (p < 0.001 ; Table V). The presence

Table I

Parents' characteristics

	Father		Mother	
	n	(%)	n	(%)
Educational level				
Illiterate	2	(1.0)	15	(7.4)
Primary education	124	(61.4)	162	(80.2)
Secondary education	56	(27.7)	21	(10.4)
University	20	(9.9)	4	(2.0)
Occupation				
Unemployed/housewife	15	(7.4)	195	(96.5)
Medical staff	3	(1.5)	4	(2.0)
Workers	133	(65.8)	2	(1.0)
Teacher	4	(2.0)	1	(0.5)
Artisan	24	(11.9)		
Others	23	(11.4)		
Median age (range) (year)	31 (21-55)		28 (18-48)	

Table II

Features of caustic substances

	n	(%)
Caustic materials		
Bleach	64	(31.7)
Grease (oven) cleaner	62	(30.7)
Lime solvent	29	(14.3)
Drain cleaner (HCl)	12	(5.9)
Dirt solvent	10	(4.9)
Detergents	7	(3.5)
Siirt's vinegar	4	(2.0)
Others	14	(7.0)
Intentions		
Drinking water	165	(81.7)
Playing game	19	(9.3)
Drinking fizzy drinks	6	(3.0)
Feeding	6	(3.0)
Drinking drug	2	(1.0)
Unknown	4	(2.0)
Sold format		
Non-original container	139	(68.8)
Dealer		
Cleaners store	69	(34.1)
Peddler	44	(21.8)
Grocery store	13	(6.4)
Supermarket	4	(2.0)
Others	4	(2.0)
Unknown	5	(2.5)
Original container	61	(30.2)
Unknown	2	(1.0)
Ingested container		
Original container	28	(13.9)
Non-original container	168	(83.1)
Water bottle	76	(37.6)
Fizzy drinks water	47	(23.3)
Glass cup	20	(9.9)
Glass bottle	9	(4.4)
Lemon juice bottle	6	(3.0)
Baby bottle	2	(1.0)
Others	14	(6.9)
Unknown	6	(3.0)
Container transparency		
Fully transparent	142	(70.3)
Opaque	44	(21.8)
Translucent green	12	(5.9)
Unknown	4	(2.0)
Container size		
100-500 cc	98	(48.5)
750-1.500 cc	69	(34.2)
≥ 2.000 cc	29	(14.3)
Unknown	6	(3.0)

or absence of oropharyngeal lesions was not significant ; however, higher-grade (severe) oropharyngeal burns (n = 16, 94.1% of patients in the OS (+) group ; n = 32, 35.9% in the OS (-) group] were associated with a higher risk for the development of OS and lower DSs (Fig. 2, Tables IV and V).

The predictive values of a DS ≤4 and the presence or absence of ISSs for OS (n = 17) among the symptomatic patients (n = 106) are shown in Table VI. A DS ≤ 4 was a clear predictor of OS (100% sensitivity, 96.63% specificity, 85% PPV, 100% NPV).

In the ED group, which was treated using our CSI management protocol, timely OGD along with early OBD were performed under the same general anaesthesia between days 10 and 14. In contrast, a late OBD was performed in LD patients who were referred late (> 21 days after CSI) with OS from another hospital for their first OBD. All patients with OS in the ED and LD groups were successfully treated by repeatedly performing OBD. The mean number of OBD procedures in the ED group was seven, compared with 22 in the LD group ($p < 0.001$). The OBD procedure intervals were 5 months in the ED group and 18 months in the LD group ($p <$ 0.001 ; Table VII).

Of 249 OBD sessions, four oesophageal perforations occurred in three patients (two perforations in one patient in the LD group, one perforation each in two patients in the ED group), and all were treated conservatively. TPN was only used to feed patients with a perforation.

Discussion

CSI injury remains a health issue, particularly in developing countries and Turkey, as legal sanctions have not been applied effectively (1, 2, 5, 7, 8, 13). Most cases of CSI are due to the transfer of caustic substances to smaller, non-original bottles (e.g., small plastic water bottles). These caustic substances are sold cheaply by peddlers or cleaning-material sellers to lower-income families (8, 13). In our series, most cases of CSI and most OS after CSI were due to the storage of caustic

Table III

Features of caustic ingestion accidents

	n	(%)
Season		
Summer	77	(38.1)
Spring	64	(31.7)
Autumn	44	(21.8)
Winter	17	(8.4)
Scene		
Parents' home	144	(71.3)
Guest in another's home	44	(21.8)
Grandparents home	20	(9.9)
Relative home	18	(8.9)
Neighboring home	6	(3.0)
Outdoors	5	(2.4)
School	3	(1.5)
Car	3	(1.5)
Cleanings store	1	(0.5)
Hotel	1	(0.5)
Unknown	1	(0.5)
Place		
Kitchen	104	(51.5)
Living room	33	(16.3)
Sink/bathroom/toilet	33	(16.3)
Outdoors	7	(3.5)
Others	19	(9.4)
Unknown	6	(3.0)
First aid		
Doing nothing	73	(36.1)
Drinking water/dairy	53	(26.3)
Getting to vomit	33	(16.3)
Washing mouth	29	(14.4)
Unknown	14	(6.9)

substances in non-original containers ; grease cleaners are particularly dangerous because they appear similar to water. Most of the patients' parents had low incomes and were poorly educated (Table I). A considerable number (21.8%) of CSI accidents occurred during visits to another individual's house.

Although no serious conflicts exist regarding first aid after CSI, unfortunately, confusion and ambiguity still exist during diagnosis, follow-up, and treatment after admission to hospital. Emergency medicine physicians, paediatricians, paediatric gastroenterologists, and paediatric surgeons encountering CSI injuries are faced with different ISSs due to the amount, kind, and chemical content of the material ingested ; the duration of contact ; and variations in concentration. When OGD became well known, it was initially recommended for all CSI patients, but the procedure is currently recommended only for patients with ISSs and those who have ingested a caustic material intentionally, with or without ISSs (1).

Many ISSs, including drooling, reluctance to eat, oropharyngeal burns/lesions, retrosternal or abdominal pain, hematemesis, vomiting, fever, leukocytosis, epigastric or abdominal tenderness, dysphagia, and dyspnea, occur after CSI, and the majority of these symptoms are mild and last for several hours. To avoid needless OGD, some researchers have established a strong relationship between ISSs and endoscopic gastroesophageal injury and have concluded that OGD is not obligatory for all patients (4, 5, 15-18). However, some studies have reported opposite ISS results (14). A multi-centre, observational Italian study of 102 patients revealed that the presence of three or more ISSs indicates a serious oesophageal burn (4). However, no examination of the long-term complications of CSI (OS, gastric outlet obstruction, oesophageal carcinoma) was performed in that study. Additionally, neither the grade nor the duration of ISSs was measured. Grading of endoscopic gastroesophageal burns and the presence of ISSs are not considered long-term complications. OGD assesses only the gastroesophageal mucosa, whereas oesophageal muscle layer burns and necrosis leading to OS are not

Table IV

Symptoms and signs distribution in symptomatic patients (n = 106) and the results of comparison of OS (+) and OS (-) patients

	OS (-) (n = 89)	OS (+) (n = 17)		
	n (%)	n (%)	$\chi 2$	p
Drooling saliva	35 (39.3)	16 (94.1)	15.04	< 0.001
Reluctance to eat	27 (30.3)	17 (100)	25.73	< 0.001
Oropharyngeal lesions	82 (92.1)	17 (100)	0.44	0.51
Dyspnea	1 (1.1)	2 (11.8)	2.65	0.10
Hematemesis	3 (3.4)	1 (5.9)	0.00	1.00
Abdominal tenderness	11 (12.4)	4 (23.5)	0.69	0.41
Persistent fever	9 (10.1)	12 (70.6)	29.16	< 0.001

$\chi 2$, chi-square test ; OS, oesophageal stricture.

Table V

Descriptive statistics of the DROOL Score, drooling time, and leukocyte count and the results of comparisons in symptomatic patients (n = 106)

	OS (-) (n = 89)	OS (+) (n = 17)		
	mean ± SD	mean ± SD	t	p
DROOL Score	7.49 ± 1.42	2.00 ± 1.06	15.19	< 0.001
Drooling time	2.02 ± 3.40	19.88 ± 13.47	10.99	< 0.001
Leukocyte count	11.70 ± 3.40	14.94 ± 5.46	3.04	0.003

SD, standard deviation ; OS, oesophageal stricture ; t, Student's t test.

Table VI

Predictive values (%) of the DROOL Score (≤ 4) and the presence or absence of initial signs and symptoms for oesophageal stricture (n = 17) among symptomatic patients (n = 106)

	OS rate	Sens	Spec	PPV	NPV
DROOL Score (≤ 4)	17/17	100.00	96.63	85.00	100.00
Persistent fever	12/17	70.58	89.89	57.14	94.12
Reluctance to eat	17/17	100.00	69.66	38.64	100.00
Drooling saliva	16/17	94.12	60.67	31.37	98.18
Oropharyngeal lesions	17/17	100.00	7.87	17.17	100.00

OS, oesophageal stricture ; Sens, sensitivity ; Spec, specificity ; PPV, positive predictive value ; NPV, negative predictive value.

visualized accurately. Thus, OS has been reported in literature by 25-90% of cases, even for children with serious caustic burns (1, 3).

Based on our experience with closely followed CSI patients, ISSs may or may not be long lasting, and new signs and symptoms may occasionally develop. We believe that the grade and duration of ISSs may shed light on the possible presence of late complications, because a very significant difference was found between DSs and the development of OS, a long-term complication (Fig. 2, Tables V and VI). Not only the presence or absence of ISSs, but also their intensity and/or duration, were considered. The durations of drooling saliva, reluctance to eat, and other ISSs of all patients were recorded meticulously from the beginning.

Oropharyngeal lesions are a frequently occurring sign after CSI. A study of CSI in adults showed that oropharyngeal lesion burn grade is an indicator of gastroesophageal burns (15). We believe that not only the presence but also the grade of oropharyngeal lesions is important. However, although we found no significant difference between the presence/absence of oropharyngeal lesions and the development of OS, we found that higher-grade (severe) oropharyngeal burns were associated with a higher risk for the development of OS and lower DSs (Fig. 2, Tables IV and V).

Patients drool saliva because they cannot swallow due to possible oesophageal oedema, and the drooling disappears as the oesophageal oedema resolves. In patients with OS, drooling saliva continued for < 12 hours after CSI in four patients and > 12 hours in the remaining patients. No drooling saliva was observed in one patient.

Reluctance to eat occurs spontaneously with drooling saliva. Appetite increases after drooling saliva stops, but, on occasion, reluctance to eat may last longer, as supported by our observation that it may last > 24 hours in patients with OS (< 12 hours in six patients only). Dysphagia is considered an ISS in some studies, and symptoms of reluctance to eat were considered an indication of dysphagia in this study.

No ISS (except minor leukocytosis) or OS was observed in 96/202 patients. Hence, these 96 asymptomatic patients were not included in the statistical comparison, unlike other studies (4, 5, 14-16). Thus, confounding variables were eliminated when the coefficients of sensitivity, specificity, PPV, and NPV were calculated, allowing us to obtain unbiased and more sensitive coefficients in the current study. Consequently, when comparing ISSs in terms of the development of OS in a child with CSI, the presence and long duration of drooling saliva, reluctance to eat, persistent fever, high rate of leukocytosis, and especially lower DSs were of greater importance than the presence of abdominal tenderness, hematemesis, oropharyngeal lesions, or dyspnea. Thus, we are of the opinion that the DS we developed for CSI injuries is an easily applicable and non-invasive scoring method based on the presence/absence, as well as the duration and grade, of important ISSs.

Table VII

Descriptive statistics of the first dilatation time, number of dilatations, and dilatation interval, and comparison of treatment results in ED and LD patients

	ED (n = 17)	LD (n = 6)		
	mean ± SD (range)	mean ± SD (range)	t	p
First dilatation time (day)	16.29 ± 7.70 (7-38)	40.17 ± 15.83 (26-59)	4.9	< 0.001
No. of dilatation	7.00 ± 6.86 (1-22)	21.67 ± 6.80 (15-30)	4.5	< 0.001
Dilatation interval (month)	4.71 ± 4.85 (1-17)	18.00 ± 8.03 (10-28)	4.8	< 0.001

SD, standard deviation ; ED, early dilatation ; LD, late dilatation ; t, Student's t-test.

Currently, the aim of assessing a gastroesophageal injury *via* early OGD, which is recommended for symptomatic patients only within the first 48 hours, is to direct the treatment strategy (1). Nevertheless, early OGD cannot shed light on hospitalization and hospitalization duration for patients initially (1) because the main factors directing treatment in a patient with caustic burns are signs and symptoms. Patients without ISSs may be observed without hospitalization. However, those with ISSs are followed up after admission until their signs and symptoms disappear and they are eating. Early OGD indicates the necessity for intravenous nutrition only in those with grade 2 or 3 burns (1). No universal guidelines have been established for patients with caustic burns regarding the cessation of oral feeding or how long and to whom TPN should be administered (1, 13). As shown in our CSI management scheme (Fig. 1), we initiated fluid intake for those who could swallow, whereas we administered intravenous fluids only to those who could not swallow and take sufficient nutrition. Only 3/202 patients were unable to take enteral nutrition for a prolonged period (two for 72 hours and one for 96 hours), and TPN was not administered even to these patients. Hence, early OGD was not applied to our patients ; instead, they were followed up closely.

The reluctance of parents to allow OGD, particularly in patients with no or few symptoms, and a lack of clear answers to parents' questions such as, "Will permanent damage occur to my child's oesophagus ?", "Does endoscopy always leave permanent damage ?", "Will a delay or mistake occur if endoscopy is not applied ?", "Will endoscopy harm my child ?" cause both physicians and parents not to use endoscopy. In this case, a non-invasive scoring system, like an Apgar score, is needed (20). Thus, we developed the DS. We scored our patients on admission and at 24 hours and found a highly significant difference in DSs between patients with and without OS in the symptomatic group ; a DS ≤ 4 was a significant predictor of OS.

We did not apply gastrostomy, TPN, or corticosteroids and did not place nasogastric tubes in any of our patients, but none of them was hungry.

Many positive impacts of nutrition and saliva on surgical wound healing have been shown (21, 22). An empirical study of CSI in rats showed that sugar and honey have favourable effects on burns (23). However, the nutritional needs of patients suffering from CSI remain uncertain. Some reports have recommended that patients with moderate or severe burns be left hungry for more than 1 week. They proposed, without objective criteria, that foods contacting the oesophagus increase the risk of infection (13). We fed all patients whose drooling saliva had stopped, and detected no food impaction in the oesophagus with a timely (days 10-14) diagnostic OGD in patients with ongoing complaints of reluctance to eat or dysphagia.

Routine BSS is not applied in our clinic if the history is clear, as it delays diagnosis in patients with mild OS and does not allow proper access to the distal part of the OS due to slow flow. Thus, the earliest initial dilatation in the LD group was performed on day 26 after CSI. We think that this is too late to start OBD. We believe that a detailed OS diagnosis can be established by OGD and fluoroscopic OBD applied during the same session ; hence, the aim of early treatment is achieved. OS can usually be detected by OGD. However, we gather more detailed data on location, length, and severity by using fluoroscopic OBD to screen distal parts of serious stenoses and less severe lesions that cannot be detected by OGD.

OS is a major complication and develops after CSI in 7-15% of patients (4, 6, 11). In our series, OS developed after CSI in 8.4% of all patients. We believe that this low incidence was due to our CSI management protocol based on immediate feeding for all patients who can tolerate food.

Early dilatation in patients suffering from OS after CSI has positive impacts on treatment (7, 11, 12). Although initiating OBD at the third week following CSI is widely accepted, it has also been shown that earlier dilatation (within the first week) has positive impacts on treatment (1, 7, 11, 12). In our study, we applied early fluoroscopic OBD (together with timely diagnostic OGD) between days 10 and 14 and found a highly

significant difference in treatment outcomes between the ED group and the LD group, who were referred with OS to our clinic > 21 days after CSI.

Oesophageal carcinoma is a serious late complication of CSI and may develop one to three decades after a severe CSI injury (1). Early OGD, early OBD, or oesophageal by-pass surgery cannot prevent the development of oesophageal carcinoma (1). Dysplasia screening is recommended for the early detection of precancerous changes in cases of severe caustic burns that have been present for a long time. The incidence of oesophageal carcinoma in CSI patients is 1000 times the expected occurrence rate in patients of a similar age group, highlighting the need for government enforcement of sanctions such as smoking bans. We recommend screening for dysplasia and motility abnormalities in patients who have had a severe caustic injury for a long time.

Some controversies persist regarding the management of CSI in children. Further prospective and randomized clinical studies based on strong evidence are necessary. These studies should be aimed at non-invasive sign/symptom scoring, minimally invasive early diagnosis, and treatment approaches for patients who have suffered from CSI (1, 24, 25).

As most CSI accidents occur in children in Turkey because caustic substances are sold in non-original bottles to families with lower incomes and education, the prevalence of CSI accidents would decrease if the caustic substances were sold in the original child-proof containers. OS can be highly predicted by using the simple new prognostic DS (≤ 4) instead of endoscopic grading, reduced by immediate feeding instead of starvation, diagnosed earlier (10-14 days) by endoscopy only in patients with persistent dysphagia instead of late classical BSS (≥ 21 days), and treated well by starting OBD earlier.

References

1. Kay M., Wyllie R. Caustic ingestions in children. *Curr Opin Pediatr*, 2009, **21** : 651-654.
2. Otcu S., Karnak I., Tanyel F. C., Senocak M. E., Buyukpamukcu N. Biochemical indicators of caustic ingestion and/or accompanying esophageal injury in children. *Turk J Pediatr*, 2003, **45** : 21-25.
3. Riffat F., Cheng A. Pediatric caustic ingestion : 50 consecutive cases and a review of the literature. *Dis Esophagus*, 2009, **22** : 89-94.
4. Betalli P., Falchetti D., Giuliani S. *et al*. Caustic Ingestion Italian Study Group. Caustic ingestion in children : is endoscopy always indicated ? The results of an Italian multicenter observational study. *Gastrointest Endosc*, 2008, **68** : 434-439.
5. Kaya M., Ozdemir T., Sayan A., Arikan A. The relationship between clinical findings and esophageal injury severity in children with corrosive agent ingestion. *Ulus Travma Acil Cerrahi Derg*, 2010, **16** : 537-540.
6. Dogan Y., Erkan T., Cokugras F. C., Kutlu T. Caustic gastroesophageal lesions in childhood : an analysis of 473 cases. *Clin Pediatr (Phila)*, 2006, **45** : 435-438.
7. Erdogan E., Eroglu E., Tekant G. *et al*. Management of esophagogastric corrosive injuries in children. *Eur J Pediatr Surg*, 2003, **13** : 289-293.
8. Gun F., Abbasoglu L., Celik A., Salman E. T. Early and late term management in caustic ingestion in children : a 16-year experience. *Acta Chir Belg*, 2007, **107** : 49-52.
9. Bicakci U., Tander B., Deveci G., Rizalar R., Ariturk E., Bernay F. Minimally invasive management of children with caustic ingestion : Less pain for patients. *Pediatr Surg Int*, 2010, **26** : 251-255.
10. Kayaalp L., Odabasi G., Dogangun B. *et al*. Corrosive esophagitis in children : Social and psychological aspects. *Turk Pediatri Arsivi*, 2006, **41** : 24-30.
11. Tiryaki T., Livanelioglu Z., Atayurt H. Early bougienage for relief of stricture formation following caustic esophageal burns. *Pediatr Surg Int*, 2005, **21** : 78-80.
12. Baskin D., Urganci N., Abbasoglu L. *et al*. A standardised protocol for the acute management of corrosive ingestion in children. *Pediatr Surg Int*, 2004, **20** : 824-828.
13. Elicevik M., Alim A., Tekant G. T. *et al*. Management of esophageal perforation secondary to caustic esophageal injury in children. *Surg Today*, 2008, **38** : 311-315.
14. Gaudreault P., Parent M., McGuigan M. A., Chicoine L., Lovejoy F. H. Jr. Predictability of esophageal injury from signs and symptoms : a study of caustic ingestion in 378 children. *Pediatrics*, 1983, **71** : 767-770.
15. Havanond C., Havanond P. Initial signs and symptoms as prognostic indicators of severe gastrointestinal tract injury due to corrosive ingestion. *J Emerg Med*, 2007, **33** : 349-353.
16. Crain E. F., Gershel J. C., Mezey A. P. Caustic ingestions. Symptoms as predictors of esophageal injury. *Am J Dis Child*, 1984, **138** : 863-865.
17. Gupta S. K., Croffie J. M., Fitzgerald J. F. Is esophagogastroduodenoscopy necessary in all caustic ingestions ? *J Pediatr Gastroenterol Nutr*, 2001, **32** : 50-53.
18. Lamireau T., Rebouissoux L., Denis D., Lancelin F., Vergnes P., Fayon M. Accidental caustic ingestion in children : is endoscopy always mandatory ? *J Pediatr Gastroenterol Nutr*, 2001, **33** : 81-84.
19. Pelclova D., Navratil T. Do corticosteroids prevent oesophageal stricture after corrosive ingestion ? *Toxicol Rev*, 2005, **24** : 125-129.
20. Apgar V. A proposal for a new method of evaluation of the newborn infant. *Curr Res Anesth Analg*, 1953, **32** : 260-267.
21. Dodds M. W., Johnson D. A., Yeh C. K. Health benefits of saliva : a review. *J Dent*, 2005, **33** : 223-233.
22. Chan M. M., Chan G. M. Nutritional therapy for burns in children and adults. *Nutrition*, 2009, **25** : 261-269.
23. Zeybek N., Yildiz F., Gunal A. *et al*. The efficacy of medical honey in experimental caustic esophageal burn. *Erciyes Univ Vet Fak Derg*, 2009, **6** : 13-19.
24. Nuutinen M., Uhari M., Karvali T., Kouvalainen K. Consequences of caustic ingestions in children. *Acta Paediatr*, 1994, **83** : 1200-1205.
25. Elshabrawi M., A-Kader H. H. Caustic ingestion in children. *Expert Rev Gastroenterol Hepatol*, 2011, **5** : 637-645.

Dr. I. Uygun, M.D., Assistant Professor
Department of Paediatric Surgery
Dicle University
Faculty of Medicine
21280, Diyarbakir, Turkey
Tel. : +90-412-2488001
Fax : +90-412-2488523
E-mail : iuygun@hotmail.com