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# Epidemiology of Caustic Esophagitis and Factors Associated with the Severity of Endoscopic Lesions in the City of Bouake in Ivory Coast

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## Abstract

**Objective:** To identify the clinical and endoscopic characteristics of caustic esophageal burns and the factors associated with the severity of lesions in a semi-rural setting. **Patients and methods:** This was a retrospective descriptive and analytical study based on gastroscopy reports from various digestive endoscopy centers in the city of Bouaké, covering the period from January 2018 to December 2022. All patients who underwent gastroscopy within 7 days following caustic ingestion were included. **Results:** Of the 7491 upper gastrointestinal endoscopies performed during the study period, only 39 cases were included, yielding a prevalence of 0.52%. The study population comprised 23 men and 16 women, with a sex ratio of 1.44. The mean age was 23.2 years (range: 1 to 83 years). A total of 28.21% of the patients came from rural areas. The ingested caustic substance was alkaline in 53.85% of cases. Suicidal intent was noted in 58.97% of cases. Clinical manifestations were observed in 69.23% of patients, with odynophagia being the most common symptom (70.37%). Mucosal abnormalities were found in 64.10% of patients. According to the Zargar classification, 38.46% of the observed lesions were severe. Analytical analysis revealed that living outside the city and ingestion of an acidic substance were significantly associated with the severity of the lesions. **Conclusion:** Caustic ingestion in the semi-rural population of Bouaké primarily affected young individuals in a suicidal context. ENT symptoms were relatively frequent, and endoscopy revealed a high proportion of severe lesions which is significantly associated with residence outside the city and with acid ingestion. These findings are consistent with data from urban populations.

**Keywords**

Caustic Ingestion, Epidemiology, Endoscopy, Rural

## 1. Introduction

Caustic esophagitis is a relatively common pathological condition that affects all regions of the world [1]. In 2004, the WHO noticed that the global incidence of Caustic esophagitis was 110 cases per 100,000 inhabitants per year [2]. Due to its often fatal complications, it represents a major public health problem, particularly among children [3]. In Western countries, the incidence of caustic ingestion varies slightly from one region to another, with relatively stable morbidity [4]. A recent study conducted in France over a 10-year period (2010-2019) [5] reported 3544 patients admitted to emergency care after ingesting caustic substances. In Africa, data are limited, and incidence rates vary by region. In Morocco, caustic ingestions account for 3.5% of pediatric hospitalizations [6], while in Tunisia, they represented 45% of domestic accidents involving children over a five-year period [7]. In sub-Saharan Africa, several studies have been conducted in different countries, often yielding contradictory results. For example, in Senegal, the annual hospital prevalence reached 3.44% in children [8], while in Côte d'Ivoire, it was 1.2% among adults [9]. However, these data primarily concern populations from major urban centers, which, despite their diversity, do not necessarily reflect the situation across the entire sub-region. This is particularly true in areas with large rural populations, where traditional practices remain influential and there is an increased reliance on traditional healers. Furthermore, the socioeconomic vulnerability and limited financial resources in these regions commonly represent additional barriers to the early management of diseases. Thus, our objective was to identify the clinical and endoscopic characteristics of esophageal lesions caused by caustic ingestion, and the factors associated with their severity in an urban context that receives many patients from surrounding rural areas.

## 2. Patients and Methods

This was a retrospective descriptive and analytical study conducted over a 5-year period (January 2018 - December 2022) in the four main digestive endoscopy centers of the city of Bouaké. All procedures were performed by experienced gastroenterologists. Patients were included in the study if they underwent upper gastrointestinal endoscopy within 7 days following caustic ingestion, regardless of age. The data were obtained from the digital registries of endoscopy centers, where the various variables were recorded using a standardized questionnaire tailored to the indication for endoscopy. The collected data included sociodemographic characteristics, circumstances of caustic ingestion, clinical manifestations, and the endoscopic appearance of esophageal lesions based on the Zargar classification. This classification was defined as follows: Grade 0: normal endoscopy; Grade I: muco-

sal erythema and edema; Grade IIa: superficial ulcerations, erosions, blisters, whitish exudates, localized submucosal hemorrhage; Grade IIb: deep ulcerations, focal necrosis, gray or brownish exudates, circumferential hemorrhages, potential pseudomembrane formation; Grade IIIa: focal or patchy deep necrosis, black or brown in appearance, non-circumferential; Grade IIIb: extensive, circumferential black necrosis with major tissue loss; Grade IV: perforation [10]. Endoscopy reports with more than 30% missing data were excluded. Data analysis was performed using EPI Info 7 statistical software. Qualitative variables were expressed as proportions, and quantitative variables were expressed as means, standard deviations, and extreme values. The analysis was conducted in two phases: initially, a descriptive analysis (means and frequencies) of the studied variables was conducted, followed by a univariate and multivariate analysis searching for esophageal lesion severity associated factors. Statistical tests used were either the chi-square test or Fisher's exact test, depending on sample size. Differences were considered statistically significant if the p-value was ≤ 0.05.

## 3. Results

Out of the 7491 upper gastrointestinal endoscopies performed during the study period, only 39 cases met the inclusion criteria, yielding a prevalence of 0.52%. The study population consisted of 23 males and 16 females, corresponding to a sex ratio of 1.44. The mean age of the patients was 23.2 ± 16.73 years, with ages ranging from 1 to 83 years. Age distribution by group is presented in **Table 1**.

**Table 1.** Age group distribution.

| Age group | Number (n) | Frequency (%) |
|---|---|---|
| ≤ 15 years | 10 | 25.64% |
| 15–25 years | 13 | 33.33% |
| 25–35 years | 10 | 25.64% |
| > 35 years | 6 | 15.38% |

With a proportion of 30.76%, farmers were the most represented group. More than a quarter of the study population (28.21%) came from a rural area. All sociodemographic characteristics are summarized in **Table 2**.

The caustic substance involved was exclusively in liquid form. In 53.85% of cases, the ingested substance was a base, and the quantity ingested was considered large in 20.51% of cases. A self-harm intention was identified in 58.97% of cases. Among adults, acids were more commonly used, accounting for 57.17% of cases, and the ingestion was intentional in 72.41% of them. In contrast, among children, bases were responsible in 80.0% of cases, with two instances of suicidal intent reported in girls aged 12 and 14.

Clinical manifestations were observed in 69.23% of the patients and were predominantly odynophagia, present in 70.37% of cases. **Table 3** highlights the dif-

ferent clinical symptoms reported, along with their respective proportions.

**Table 2.** Sociodemographic characteristics of the patients.

| Category | Number (n) | Proportion (%) |
|---|---|---|
| Sex | | |
| Male | 23 | 58.97% |
| Female | 16 | 41.03% |
| Age | | |
| ≤ 25 years | 23 | 58.97% |
| > 25 years | 16 | 41.03% |
| Residence | | |
| Bouaké | 24 | 61.54% |
| Outside Bouaké | 15 | 38.46% |
| Residence area | | |
| Urban | 28 | 71.79% |
| Rural | 11 | 28.21% |
| Occupation | | |
| Farmers | 12 | 30.76% |
| Laborers | 5 | 12.82% |
| Traders | 2 | 5.13% |
| Students/Scholars | 9 | 23.08% |
| Homemakers | 2 | 5.13% |
| Unemployed | 9 | 23.08% |
| Category | Number (n) | Proportion (%) |
| Sex | | |
| Male | 23 | 58.97% |
| Female | 16 | 41.03% |

**Table 3.** Distribution of symptoms.

| Symptom | Number (n) | Population frequency (%) | Symptomatic frequency[a] (%) |
|---|---|---|---|
| Dysphagia | 9 | 23.08% | 33.33% |
| Dyspnea | 2 | 5.13% | 7.41% |
| Hematemesis | 5 | 12.82% | 18.52% |
| Hypersalivation | 11 | 28.21% | 40.74% |
| Odynophagia | 19 | 48.72% | 70.37% |
| Vomiting | 7 | 17.95% | 25.93% |
| ENT signs[b] | 15 | 38.46% | 55.56% |
| None | 12 | 30.77% | |

[a]Symptomatic frequency: Ratio of the symptom to the total number of symptomatic patients (n = 27). [b]ENT signs: dysphonia, pharyngeal pain, sensation of pharyngeal foreign body.

In two-thirds of the patients, the examination was performed within the first 72 hours following ingestion, revealing various and combined lesions in 62.5% of cases. Table 4 provides an overview of the lesions observed during endoscopy.

Table 4. Endoscopic findings.

| Observed lesions | Number (n) | Frequency (%) |
|---|---|---|
| Erythema | 6 | 15.38% |
| Edema | 4 | 10.26% |
| Ulceration | 19 | 48.72% |
| Necrosis | 7 | 17.95% |
| Pseudomembrane | 6 | 15.38% |
| Perforation | 1 | 2.56% |
| None | 14 | 35.89% |

Mucosal abnormalities were observed in 64.10% of patients, ranging from simple erythema to more or less extensive necrosis and even perforation. In 41.67% of cases, the lesions involved the entire esophageal mucosa. According to the Zargar classification, 38.46% of the observed lesions were considered severe. The different stages of this classification and their frequencies are presented in Table 5.

Table 5. Severity of lesions according to the Zargar classification.

| Stage | | Number (n) | Frequency (%) | |
|---|---|---|---|---|
| Grade 0 | | 14 | 35.90 | |
| Grade I | | 4 | 10.26 | |
| Grade II | a | 6 | 15.38 | 33.33 |
| | b | 7 | 17.95 | |
| Grade III | a | 4 | 10.26 | 17.95 |
| | b | 3 | 7.69 | |
| Grade IV | | 1 | 2.56 | |

Univariate analysis identified two factors that were significantly associated with the severity of endoscopic lesions: place of residence and the chemical nature of the ingested caustic substance. Patients living outside the city of Bouaké had a significantly higher proportion of severe lesions observed on endoscopy ($p = 0.029$). Similarly, the ingestion of an acidic substance was significantly associated with severe lesions ($p = 0.01$). Table 6 summarizes the different parameters potentially associated with lesion severity along with their levels of significance.

Multivariate analysis using logistic regression, as presented in Table 7, confirmed that residence outside of Bouaké (OR = 3.91; 95% CI [1.27 - 12.00]; $p = 0.017$) and the acidic nature of the ingested substance (OR = 4.10; 95% CI [1.44 - 11.63]; $p = 0.008$) were independently associated with an increased risk of severe

lesions.

**Table 6.** Factors associated with severity of endoscopic lesions in univariate analysis.

| Factors | Minimal lesions n (%) | Severe lesions n (%) | Test used | p-value |
|---|---|---|---|---|
| | Place of residence | | | |
| In the city | 18 (75.0) | 6 (25.0) | Chi-square | 0.029 |
| Outside the city | 6 (40.0) | 9 (60.0) | | |
| | Chemical nature | | | |
| Acidic | 7 (38.89) | 11 (61.11) | Fisher | 0.01 |
| Base | 17 (80.95) | 4 (19.05) | | |
| | Circumstances of ingestion | | | |
| Accidental | 10 (62.5) | 6 (37.5) | Chi-square | 0.918 |
| Voluntary | 14 (60.87) | 9 (39.13) | | |
| | Time to medical care | | | |
| Within 3 days | 18 (69.23) | 8 (30.77) | Chi-square | 0.162 |
| After 3 days | 6 (46.15) | 7 (53.85) | | |
| | Induced vomiting | | | |
| Yes | 14 (56.0) | 11 (44.0) | Fisher | 0.496 |
| No | 10 (71.43) | 4 (28.57) | | |

**Table 7.** Factors Associated with the severity of lesions in multivariate analysis.

| Facteurs | $\beta$ Coefficient | Erreur standard | Adjusted OR | IC95% | p-value |
|---|---|---|---|---|---|
| Living outside the city | 1.36 | 0.57 | 3.91 | 1.27 - 12.00 | 0.017 |
| Acid ingestion | 1.41 | 0.53 | 4.10 | 1.44 - 11.63 | 0.008 |
| Voluntary ingestion | 0.52 | 0.48 | 1.68 | 0.65 - 4.31 | 0.284 |
| Initial care after 3 days | 1.11 | 0.60 | 3.04 | 0.94 - 9.84 | 0.063 |
| Induced Vomiting | 0.72 | 0.46 | 2.05 | 0.83 - 5.05 | 0.119 |

## 4. Discussion

Out of the 7491 reports analyzed over the 5-year period, only 39 patients were included in the study, resulting in a prevalence of 0.52%. This value was similar to that reported in a comparable population in Bobo-Dioulasso, which was 0.6% [11]. However, Kouamé in Abidjan reported a significantly higher prevalence of 1.2% [9]. Although prevalences vary from study to study, the general trend seems to indicate that this is a relatively rare pathological condition. For instance, a series from Benin in 2020 included only 49 children over 14 years of study [12], while in Spain, Ripoll-Trujillo included only 89 patients under 18 years of age out of a sample of 487,099 individuals, corresponding to a proportion of 0.02% [13]. This finding was consistent with the literature, both in Africa and in Western countries

[14] [15], although the prevalence appeared to be even lower in rural areas.

The mean age of the study population was 23.2 ± 16.73 years, with a range from 1 to 83 years. This is consistent with the results from studies conducted in the sub-region, as evidenced by Thot'o in Côte d'Ivoire and Saké in Benin, with respective mean ages of 22.24 years [16] and 25.54 years [17]. Further away in Pakistan, Hashmi reported a similar mean age (23.4 years) in a rural population comparable to ours [18]. This finding confirms that caustic ingestion primarily affects the young active population.

The sex ratio observed in our study was 1.44, a value close to those reported in the Nigerian and Ghanaian series, which were 1.54 [19] and 1.41 [20], respectively. However, the literature data show variability according to the regions. Some studies reported predominance of male, with a sex ratio of 2.8 in Abidjan, Côte d'Ivoire [21], and 3.8 in Parakou, Benin [17]. In contrast, other studies have reported a female predominance, as evidenced by a sex ratio of 0.9 in a study conducted in Dakar [22], and ratios of 0.8 and 0.52 in rural populations in Burkina Faso [11] and Pakistan [18], respectively.

In our study, 28.21% of patients came from rural areas, a rate significantly higher than the 4% reported in the Abidjan series [16]. This difference can be explained by the distinct demographic structure of the two cities: Abidjan, the economic capital of the country, is predominantly urban, whereas Bouaké, although the second-largest city, remains strongly influenced by the surrounding rural populations. On an international scale, this geographical distribution can vary considerably. For instance, in Pakistan, an even higher proportion of patients, 52.9%, came from rural areas [18], highlighting the significant impact of geographical and socio-economic context on the epidemiology of caustic ingestions.

The caustic substances most frequently involved in our series were bases, accounting for 53.85% of cases. This result is consistent with several studies, including a study conducted in Benin, where bases were found in 58.33% of cases [17], as well as a Congolese series reporting a prevalence of 54.4% [23]. In some regions, the use of bases as caustic agents reached even higher proportions. This was the case in Nigeria, where bases were involved in 78.6% of poisonings [19], or in Spain, where they represented 71.9% of cases [13]. Conversely, other studies highlighted a predominance of acids, such as those by Kouamé and Koura, who reported respective proportions of 67.5% [9] and 66.67% [11]. This trend was also observed in North Africa, particularly in Morocco, where a study found acid in 61.1% of caustic ingestion cases [24]. Furthermore, compared to a semi-rural population similar to ours, acids were the most commonly involved agents, accounting for 66.67% of cases in Burkina Faso [11] and 74.3% in Pakistan [18]. These variations can be primarily explained by the accessibility and use of caustic products depending on the region. In sub-Saharan Africa, bases, such as caustic soda, are commonly used in the artisanal production of soap or for domestic maintenance, which increases their involvement. In contrast, in North Africa and Eu-

rope, acids are more widespread in industry and household products, which increases their prevalence in poisonings. Additionally, cultural differences and modes of exposure, particularly in voluntary ingestions, also influence these trends.

The suicidal intent behind the ingestion was confirmed in 58.97% of cases, a rate consistent with findings reported in the literature. Local series, such as the one conducted in Abidjan, reported a similar prevalence of 60.0% [16], while other studies, notably in Burkina Faso and Nigeria, reported higher rates of 83.33% in a semi-rural population [11] and 71.4% among patients from a large urban center [19], respectively. In Asia, this proportion reached 95.6%, illustrating significant geographic and cultural disparities especially in rural populations. [18]. However, this high prevalence of suicidal intent was not universal globally. An older Brazilian study highlighted a predominance of accidental ingestions, representing 67.6% of cases [25]. This variation could be attributed to socio-economic, cultural factors, as well as the accessibility of caustic substances, which influence exposure patterns. Additionally, the demographic profile of patients impacts these findings, with a higher frequency of intentional acts among adults compared to children [14] [23] [26]. These data underline the need to develop prevention strategies tailored to local specifics, emphasizing the regulation of caustic substances and raising awareness of the risks associated with their ingestion.

In our series, symptoms were observed in 69.23% of patients, a rate similar to that reported in a study in Abidjan, which indicated 72.0% [16]. Other authors have noted that clinical symptoms suggestive of caustic injuries, such as odynophagia, dysphagia, hypersalivation, and vomiting, were less frequent, representing only 43.8% of cases [13]. Odynophagia, with a prevalence of 70.37%, proved to be the dominant symptom in our series, a finding also observed in several studies, particularly in Pakistan, where it represented 79.1% of cases [18]. Furthermore, in our series, ENT symptoms were relatively frequent, with a prevalence of 55.56%. These manifestations are not uncommon after the ingestion of caustic substances, as indicated in certain studies. For example, in Burkina Faso, Koura reported a prevalence of 38.89% [11].

The interpretation of clinical manifestations following caustic substance ingestion is debated in the literature. In fact, some researchers, such as Bird [27] and Bonnici [28], suggested in their studies that asymptomatic adults would not require diagnostic tests or hospitalization. However, this approach is contested by other authors who emphasized that the absence of pain should not systematically rule out the presence of digestive lesions, whether early or late [29].

Although largely surpassed by CT scans in the description of lesions, upper digestive endoscopy still holds its place in a healthcare setting with limited resources and financial constraints. In our study, endoscopy was performed within 72 hours of caustic ingestion for 69.23% of the patients, with an average procedure time of 3 days and 5 hours. This delay was shorter than that observed in the Beninese series, where only 50.0% of patients had the exam within the week following the incident [17]. Other authors, such as Olugbemiga in Nigeria [19] and Ngoné in

Senegal [22], reported an average delay of 48 hours. However, this delay was considerably longer than the 24 hours observed in 72.2% of patients in the Moroccan series [24]. This delay in performing endoscopy, frequently observed in Sub-Saharan countries, could be attributed to delayed hospital admissions, often linked to self-medication with substances such as milk, palm oil, or decoctions, as well as financial constraints limiting rapid access to specialized care.

Endoscopic examinations revealed a range of lesions, from simple erythemas to more or less extensive necroses, often associated with each other. This finding was also reported in the literature, particularly in Benin [17]. In our study, lesions were observed in 64.10% of patients, which aligns with data reported in the literature. In the Abidjan series, 64% of cases showed visible lesions [16], while in the Moroccan series, this proportion was 66.6% [24]. These results confirm the significant prevalence of lesions observed after the ingestion of caustic substances and emphasize the importance of close clinical monitoring, particularly for patients with initially mild symptoms, in order to detect potential late lesions. According to Zargar's classification, 32.0% of the lesions observed in our series were considered severe. A similar result was obtained in the Moroccan series, where 32.21% of the lesions were classified as severe [24]. However, this trend is not universal, as evidenced by the studies of Koura in a population with comparable profiles to that of our study cohort and Bedou, which reported 66.67% [11] and 64.16% of severe lesions, respectively [30]. The heterogeneity of the proportions of severe lesions reported in different studies raises questions about the factors influencing these variations, whether they are related to the characteristics of the populations studied, the types and amounts of substances ingested, or the timing of medical intervention.

The analysis of our series revealed a significant association between residence outside the city of Bouaké and the severity of endoscopic lesions (OR = 3.91; 95% CI [1.27 - 12.00]; p = 0.017). This observation could be explained by a delay in medical management, related to a longer healthcare pathway before reaching the reference center located in Bouaké. This result contrasts with the data reported by Kouamé in Abidjan [9]. Furthermore, the ingestion of an acidic caustic agent was also associated with more severe lesions (OR = 4.10; 95% CI [1.44 - 11.63]; p = 0.008). This finding aligns with the results of a study conducted in Abidjan [9], although it differs from the one reported by Thot'O [16].

## 5. Study Limitations

Despite the rigorous methodology employed, this study presents certain limitations. One major shortcoming is the lack of quantification of the caustic substance ingested. Although this parameter is likely to significantly influence the severity of endoscopic lesions, it remains challenging to assess objectively in routine clinical settings. Another limitation is the absence of an analysis regarding the influence of sociodemographic factors on the circumstances surrounding caustic ingestion, particularly in cases of intentional ingestion or suicide attempts. This omis-

sion is attributable to the study's primary focus on identifying factors associated with the severity of endoscopic injuries. Furthermore, therapeutic aspects were not explored, as they would have required a distinct methodological approach. These issues merit further investigation in future studies.

## 6. Conclusion

Caustic ingestion in the semi-rural population of Bouaké predominantly affected young individuals, with suicidal intent in the majority of cases. Alkaline substances, which are more readily accessible, were the most commonly used caustic agents. The resulting clinical picture was primarily characterized by odynophagia, though otolaryngological signs, which were also frequent, should not be overlooked. The relatively high proportion of severe lesions, which is significantly associated with residence outside the city and with acid ingestion, remains concerning due to their potential progression towards complications. These observations are consistent with the epidemiological and clinical data reported in the sub-region, regardless of the sociodemographic characteristics of the studied cohorts. They emphasize the need for a multidimensional approach, integrating better regulation of access to caustic agents and strengthened prevention strategies to reduce the morbidity and mortality associated with these poisonings.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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