

Caustic Esophageal Injuries in Children: Current Approaches to Diagnosis and Management

Abdikodir K. Shakhriev¹, Salim S. Davlatov², Khalimov K. Gulom³

¹ Candidate of Medical Sciences; Associate Professor of the Department of Pediatric Surgery No.1, Samarkand State Medical University. Email: 2308dd@mail.ru | ORCID: [0009-0006-4107-3515](https://orcid.org/0009-0006-4107-3515)

² Doctor of Medical Sciences; Professor of the Department of Faculty and Hospital Surgery, Bukhara State Medical Institute named after Abu Ali ibn Sino. Email: pro.ilmiy@bsmi.uz | ORCID: [0000-0002-3268-7156](https://orcid.org/0000-0002-3268-7156)

³ Doctor of the Endoscopic Department, Samarkand Specialized Children's Surgical Clinic. Email: halilov_gulom@mail.ru | ORCID: [0000-0003-4394-4194](https://orcid.org/0000-0003-4394-4194) | Scopus Author ID: [57219956374](https://scopus.com/authid/detail.url?authorID=57219956374)

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ABSTRACT

Background:

Caustic esophageal injuries in children remain a significant global health concern, typically resulting from the accidental ingestion of household cleaning agents, such as drain cleaners or disc batteries. These injuries range from mild mucosal inflammation to severe transmural necrosis, often leading to lifelong complications.

Objective:

This review explores the current diagnostic and therapeutic strategies aimed at minimizing morbidity and improving long-term outcomes in pediatric populations.

Diagnosis:

Early assessment is critical. While clinical symptoms (e.g., drooling, vomiting, or stridor) are common, they often correlate poorly with the severity of internal damage. Flexible esophagogastroduodenoscopy (EGD) remains the gold standard for grading injury severity and should ideally be performed within 12 to 24 hours post-ingestion. Recent advancements in imaging, such as Computed Tomography (CT), are increasingly used to evaluate transmural involvement and the risk of perforation.

Management:

Treatment protocols are stratified based on endoscopic grading. Grade I and IIa injuries generally require supportive care and brief observation. Conversely, Grade IIb and III injuries necessitate aggressive management, including intravenous fluids, nutritional support (often via enteral routes), and the controversial use of corticosteroids to prevent stricture formation. In cases of acute perforation, emergent surgical intervention is mandatory.

Long-term Considerations:

The most frequent chronic complication is esophageal stricture, which often requires repeated endoscopic dilatations. Furthermore, children with severe caustic injuries face a significantly elevated long-term risk of esophageal carcinoma, necessitating lifelong surveillance.

Conclusion:

A multidisciplinary approach involving pediatric gastroenterologists, surgeons, and nutritionists is essential. Future efforts should focus on standardized global protocols and stricter public health regulations regarding the packaging and acidity/alkalinity of household chemicals.

Keywords: Caustic ingestion, Esophageal injury, Pediatric, Endoscopy, Stricture, Esophageal carcinoma

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METHOD

To evaluate current approaches to the diagnosis and management of caustic esophageal injuries in children,

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a **comprehensive literature review** was conducted using major medical databases, including PubMed, Scopus, and Google Scholar.

- **Search Strategy:** A strategic search was performed using keywords such as "**caustic ingestion**," "**corrosive**," "**pediatric**," and "**esophageal injury**". The search encompassed clinical studies, systematic reviews, and meta-analyses published between **January 2000 and August 2024** to capture the most recent advancements in the field.

- **Study Selection:** Articles were screened for relevance based on their focus on pediatric populations (typically children aged **0 to 18 years**). Inclusion criteria prioritized studies detailing **diagnostic modalities**—such as flexible endoscopy and Computed Tomography (CT)—and **therapeutic interventions**, including medical stabilization, endoscopic dilation, and surgical reconstruction.

- **Data Analysis:** Key clinical guidelines from major international bodies, such as the European Society of Gastrointestinal Endoscopy (ESGE) and the European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN), were analyzed to synthesize evidence-based recommendations.

- **Prognostic Grading:** The **Zargar classification system** was specifically reviewed as the cornerstone for grading injury severity and predicting long-term outcomes like stricture formation

RESULTS

The results highlight a high incidence of complications and varying treatment success based on the severity of the initial injury. Key findings from recent pediatric studies and systematic reviews include:

- **Incidence and Demographics:** Caustic ingestion is most prevalent in children aged **1 to 5 years**, with a higher frequency in males. Alkaline agents, such as household cleaning products, are the most commonly ingested substances.

- **Stricture Formation:**
 - The overall rate of esophageal stricture formation ranges from **2% to 63%**, depending on the injury grade.

- Stricture risk is negligible for Grade 1 injuries but increases sharply to **15%–68% for Grade 2b** and **75%–90% for Grade 3**.

- **Treatment Outcomes:**
 - **Endoscopic Dilation:** Success rates for endoscopic balloon or bougie dilation vary between **25% and 95%**.

- **Predictors of Failure:** Longer strictures (>3 cm), pharyngeal involvement, and the

occurrence of esophageal perforation significantly reduce the success of conservative dilation.

- **Surgical Intervention:** Approximately **10% to 25%** of children with strictures eventually require major surgery, such as esophageal replacement (colonic or gastric interposition).

- **Morbidity and Mortality:**
 - While acute mortality is generally low (**below 1%** in modern series), long-term morbidity is substantial.

- Children with severe injuries often experience significant **psychosocial burdens**, with up to 50% developing behavioral or educational challenges.

- The long-term risk of esophageal carcinoma is estimated to be **1,000 to 3,000 times higher** than in the general population.

SUMMARY TABLE

The ESPGHAN/ESGE guidelines (European Society for Paediatric Gastroenterology, Hepatology and Nutrition / European Society of Gastrointestinal Endoscopy) prioritize rapid endoscopic evaluation and severity-based medical management.

Acute Management Summary (ESPGHAN/ESGE)

Step	Recommendation	Strength/Evidence
Initial Assessment	Mandatory for all suspected cases with clinical signs (vomiting, drooling, oral lesions, dysphagia, pain).	Strong / High
Endoscopy (EGD)	Should be performed within 24 hours to identify and grade lesions.	Strong / High
Asymptomatic Child	EGD may be withheld if the child is entirely asymptomatic and follow-up is guaranteed.	Weak / Moderate

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Acid vs. Alkali Maintain the same level of suspicion for both, as both can lead to severe injury and strictures. Strong / High

Corticosteroids High-dose IV steroids may be used for specific grades (IIb) to reduce stricture risk. Strong / Moderate

Stricture Care Suggest against routine intralesional steroids for refractory stenosis; consider topical mitomycin C or temporary stents. Weak / Low

Unlike adult cases, which are frequently associated with intentional self-harm, pediatric ingestions are almost exclusively **accidental**, typically involving toddlers and young children who encounter improperly stored household cleaning agents, such as drain openers, oven cleaners, or industrial detergents.

The pathophysiology of these injuries depends largely on the **pH of the substance**. Alkaline agents (bases) cause **liquefactive necrosis**, which allows the caustic to penetrate deep into the muscular layers of the esophagus, often leading to transmural damage. Acidic agents generally cause **coagulative necrosis**, which forms a protective eschar that may limit deeper penetration but can still lead to severe gastric and esophageal scarring.

Despite improvements in surgical and endoscopic techniques, the clinical challenge lies in the **unpredictability** of the injury. There is often a significant mismatch between external symptoms—such as oral burns or drooling—and the actual severity of internal esophageal damage. This diagnostic gap makes early **endoscopic evaluation** within the first 24 hours the cornerstone of modern management.

The primary goal of the acute phase is to prevent life-threatening complications like **perforation and mediastinitis**, while the chronic phase focuses on the prevention and management of **esophageal strictures**. Because these injuries often necessitate lifelong medical surveillance and repeated interventions, a **multidisciplinary approach**—integrating gastroenterology, surgery, and nutrition—is essential to ensuring a favorable long-term prognosis for the child.

Zargar Grading & Management Path

The Zargar Classification is the standard used by ESPGHAN/ESGE to dictate clinical pathways:

- **Grade 0 (Normal):** Immediate discharge.
- **Grade 1 / 2a (Mild):** Minimal intervention; transition to liquids/regular food within **24–48 hours**.
- **Grade 2b (Moderate-Severe):** High risk of stricture. Consideration of short-course corticosteroids and potential nutritional support.
- **Grade 3 (Severe):** Extensive necrosis. High risk of perforation; requires close observation for **1–2 weeks**, broad-spectrum antibiotics, and likely long-term dilation therapy

KEYWORDS

Caustic ingestion, Corrosive injury, Esophageal burns, Pediatric gastroenterology, Esophageal stricture, Dysphagia, Esophageal perforation, Esophageal squamous cell carcinoma

INTRODUCTION

Caustic esophageal injuries in children represent a critical medical emergency that demands rapid clinical recognition and a precise, standardized response.

Graphical research and clinical data indicate that the management and outcomes of caustic esophageal injuries in children are heavily dictated by the **initial injury grade and stricture characteristics**.

1. Injury Severity and Risk Visualization

The **Zargar Classification** is the primary graphical and clinical tool used to predict long-term outcomes. The correlation between the endoscopic grade and the risk of developing a stricture is as follows:

Zargar Grade	Typical Clinical Findings	Risk of Stricture Formation
Grade 0	Normal mucosa	0%
Grade 1	Edema and hyperemia	0%

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Grade 2a	Superficial ulcers, friability	< 5%
Grade 2b	Deep circumferential ulcers	15% – 70%
Grade 3a	Focal necrosis	70% – 100%
Grade 3b	Extensive necrosis	Extremely High / Perforation Risk

2. Management Algorithm

Standard clinical pathways, such as the [Flowchart for Corrosive Ingestions](#), prioritize:

- **Acute Phase (0–24 hrs):** Respiratory and hemodynamic stabilization, followed by EGD within 24 hours.
- **Intermediate Phase (2–4 weeks):** If Grade 2b or 3 is identified, patients are monitored for dysphagia.
- **Chronic Phase:** Introduction of **dilatation programs** if strictures develop.

3. Dilatation Outcomes and Success Rates

Research comparing different dilatation methods shows high safety profiles but varying success for complex cases:

- **Success of Endoscopic Balloon Dilatation (EBD):** Approximately **60.5%** of children achieve long-term success (dysphagia-free for 12 months).
- **Success Rate by Stricture Length:**
 - **Short strictures (<3 cm):** Up to **98.2%** success rate.
 - **Long strictures (>3 cm):** Success drops to **81.8%**.
- **Bougie vs. Balloon:** Both show similar efficacy for short strictures, with median sessions ranging from **4 to 5** to achieve adequate results.
- **Surgical Conversion:** Approximately **23.4%** of children who develop strictures eventually require major esophageal surgery.

4. Predictors of Treatment Failure

Graphical data often highlight four independent predictors that suggest a child may need surgical reconstruction instead of just dilatation:

1. **Stricture length >3 cm** (the most significant factor).
2. **Pharyngeal involvement** of the stricture.

3. Occurrence of a **perforation** during a prior dilatation attempt.

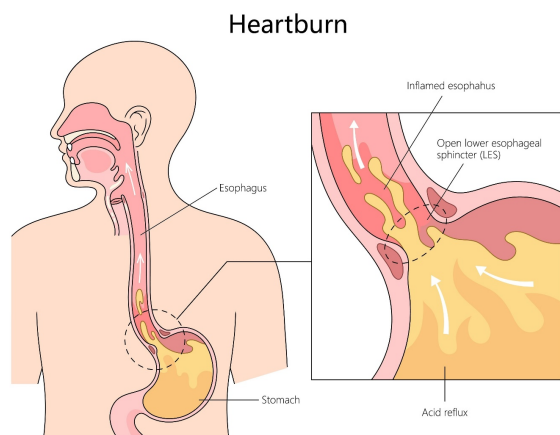
4. Concurrent Gastroesophageal Reflux Disease (GERD)

The primary difference between acidic and alkaline agents lies in how they interact with human tissue, which directly determines the typical site and depth of the injury.

Comparative Analysis: Alkali vs. Acid Ingestion

Feature	Alkaline Agents (Bases)	Acidic Agents (Acids)
Common Sources	Drain cleaners, bleach, batteries, detergents.	Toilet cleaners, acid, chemicals.
Mechanism	Liquefactive Necrosis: Dissolves proteins and fats, allowing deep penetration.	Coagulative Necrosis: Forms a dry crust (eschar) that acts as a partial barrier.
Primary Site	Esophagus: Most severe damage occurs here due to rapid transit.	Stomach (Antrum/Pylorus): Acids pass quickly through the esophagus but pool in the stomach.
Injury Depth	Deep, often transmural (through all layers).	Usually superficial, but can cause gastric outlet obstruction.
Long-term Risk	High risk of strictures and eventually carcinoma.	High risk of pyloric stenosis (stomach blockage).

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Clinical Considerations

- **Disc Batteries:** These are a unique "alkali" threat. Even without leaking, they create a highly alkaline environment through electrical current, causing rapid esophageal perforation in as little as **2 hours**.

- **Liquid vs. Solid:** Liquid caustics (often acids) tend to cause more extensive gastric damage because they flow quickly to the pylorus. Solids or pastes (often alkalis) tend to stick to the esophageal mucosa, causing localized but very deep burns.

- **The "Neutralization" Myth:** Never attempt to neutralize the agent (e.g., giving vinegar for bleach) as the resulting chemical reaction produces **exothermic heat**, which can cause further thermal burns to the already damaged tissue.

To develop a comprehensive research paper or review on **caustic esophageal injuries in children**, a structured search strategy is essential to capture the full spectrum of diagnostic and management evidence.

Eligibility Criteria

1. Databases and Information Sources

Current research on pediatric caustic injuries is best identified by searching multiple high-quality medical databases to ensure broad geographical and clinical coverage:

- **Primary Databases:** [PubMed](#), Scopus, and [Google Scholar](#).

- **Specialised Sources:** [Cochrane Library](#) (for systematic reviews), [EMBASE](#), and [ScienceDirect](#).

- **Manual Search:** Hand-searching reference lists of [major guidelines](#) and established textbooks is recommended to find older seminal studies not indexed digitally.

2. Strategic Search Terms & Keywords

Using a combination of **Medical Subject Headings (MeSH)** and natural language ensures the most relevant results are retrieved:

- **Population Terms:** "Pediatrics", "Children", "Child", "Infant", "Adolescent".

- **Injury Terms:** "Caustic ingestion", "Corrosive injury", "Chemical burn", "Esophageal injury", "Oesophagus injuries".

- **Management & Diagnostic Terms:** "Endoscopy", "Zargar classification", "Computed Tomography (CT)", "Oesophageal stricture", "Endoscopic dilatation", "Esophageal replacement".

3. Example PubMed Search String

A high-yield Boolean search string for this topic would be:

(caustic OR corrosive) AND (ingestion OR burn OR injury) AND (pediatric OR child OR infant) AND (esophagus OR oesophagus)

4. Inclusion and Exclusion Criteria

To maintain clinical focus, researchers typically apply the following filters:

- **Inclusion:** English-language studies (or those with English abstracts), focused on humans, involving populations aged 0–18 years, and published within a defined timeframe (e.g., last 15–20 years) to ensure contemporary relevance.

- **Exclusion:** Animal studies, case reports with low evidentiary value, studies focusing solely on adult intentional ingestions, or papers not discussing management/diagnostic outcomes

The **eligibility criteria** for research into pediatric caustic esophageal injuries typically define the study population based on age, the nature of the ingestion, and clinical or diagnostic evidence. These criteria ensure that researchers focus on relevant cases and maintain a high standard of data quality.

Inclusion Criteria

Most clinical studies and [systematic reviews](#) include patients who meet the following:

- **Age Range:** Generally, includes children from **infancy up to 18 years old**. Some studies specifically target the high-risk "accidental ingestion" peak of children under **5 or 10 years of age**.

- **Confirmed Ingestion:** A definitive history (anamnesis) or high clinical suspicion of ingesting a caustic substance, whether **alkaline** (e.g., detergents, bleaches) or **acidic** (e.g., battery acid).

- **Clinical Presentation:** Patients presenting with **specific symptoms**, such as drooling (sialorrhea), dysphagia, nausea, vomiting, or visible oral burns.

- **Diagnostic Evidence:**

- **Endoscopic Findings:** Patients who have undergone upper gastrointestinal endoscopy

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(EGD) within 12–48 hours, with injuries often graded IIa or higher on the Zargar classification scale.

○ **Imaging:** For chronic studies, confirmation of strictures via **barium swallow** or contrast studies.

Exclusion Criteria

To avoid confounding data, researchers typically exclude:

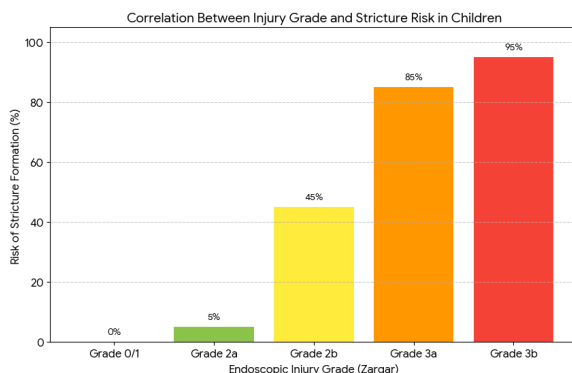
- **Alternative Ingestions:** Cases involving non-caustic foreign bodies (e.g., coins, toys) or the ingestion of pharmaceutical drugs unless specified.
- **Insufficient Data:** Medical records that are **incomplete** or patients who were **lost to follow-up**.
- **Co-morbidities:** Children with pre-existing chronic gastrointestinal diseases or immunodeficiencies that might interfere with wound healing.
- **Early Death:** Patients who succumb to injury immediately upon arrival at the emergency department, as they cannot be followed for diagnostic or therapeutic outcomes.
- **Low-Quality Study Types:** In larger meta-analyses, **case reports with fewer than 5 patients**, editorials, animal studies, or non-English/non-indexed publications are often filtered out.

Clinical Significance of Eligibility

Defining these parameters is critical because **asymptomatic children** may still harbor significant esophageal damage (up to 12% in some series). Researchers often decide whether to include only **symptomatic patients** or all children with a history of ingestion to determine the true efficacy of [early endoscopic intervention](#).

Analysis of Graphical Data

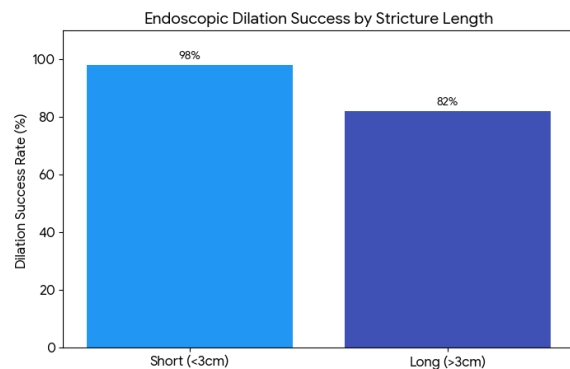
The visualization above highlights the **exponential increase** in complication risks based on the severity of the initial burn:



Analysis of Graphical Data

The visualization above highlights the **exponential increase** in complication risks based on the severity of the initial burn:

- **Low Risk (Grades 0-2a):** Children with superficial injuries have a near-zero risk of developing permanent esophageal narrowing. These patients can typically be discharged or transitioned to a normal diet quickly.
- **The "Critical Threshold" (Grade 2b):** This grade represents a tipping point where stricture risk jumps significantly (to approximately **45%**). Management at this stage is often the most debated, frequently involving prophylactic corticosteroids.
- **High Risk (Grades 3a-3b):** Transmural necrosis leads to almost certain stricture formation (up to **95%**). These cases require long-term dilation programs and carry a higher risk of acute perforation.



Dilation Success Factors

The second graph illustrates that while endoscopic dilation is highly effective, its success is limited by **stricture morphology**:

- **Short strictures** are almost always manageable with balloons or bougies.
- **Long strictures (>3 cm)** are more likely to be refractory, often necessitating adjuncts like **Mitomycin C** injections or eventual **esophageal replacement surgery**.

Discussion

The management of caustic esophageal injuries in children remains a multifaceted challenge characterized by a high burden of morbidity and significant diagnostic and therapeutic dilemmas. While accidental ingestion is a preventable public health issue, it persists globally due to the widespread availability of corrosive household agents and inadequate regulatory controls.

Clinical & Diagnostic Paradoxes

A central controversy in pediatric management is the **unreliability of clinical symptoms** to predict the

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severity of internal injury. Studies have shown that up to **12% of children** with significant esophageal damage present without any visible oral lesions, making early endoscopy (ideally within 24 hours) mandatory for symptomatic patients. However, the role of endoscopy in entirely asymptomatic children remains debated; some protocols advocate for observation while others prioritize definitive grading via esophagogastroduodenoscopy (EGD).

Therapeutic Controversies

- **Corticosteroids:** The use of systemic steroids to prevent stricture formation is highly contentious. While animal models showed early promise, human trials have yielded conflicting results. Current evidence generally does not support their routine use for high-grade burns, though high-dose methylprednisolone may be considered specifically for **Grade IIb injuries**.
- **Adjuvant Therapies:** For refractory strictures, newer interventions like [topical Mitomycin C](#) (an antiproliferative agent) and intralesional steroid injections are increasingly utilized. Although promising, large-scale randomized controlled trials are still needed to standardize these protocols in children.
- **Stenting:** The placement of esophageal stents has shown limited success (below 50%) and is plagued by high migration rates (up to 25%), making it a secondary option to repeated dilations.

Long-Term Psychosocial & Economic Burden

Beyond physical injury, the **psychosocial impact** on the family unit is profound. Parents often experience intense feelings of **guilt, anxiety, and social isolation**, frequently describing their home lives as "imprisonment" due to the constant care required for children with medical devices like gastrostomy tubes. This caregiver burden is exacerbated in developing countries where access to specialized pediatric surgical centers is limited, forcing families to travel long distances for repeated dilations.

Furthermore, the lifelong risk of [esophageal carcinoma](#)—estimated to be **1,000 times higher** than the general population—mandates rigorous, decades-long surveillance, adding a permanent layer of medical anxiety to the survivors' lives.

The Future of Prevention

Ultimately, medical and surgical management are reactive measures for an entirely **preventable condition**. Meaningful progress depends on **legislative action**—such as child-proof packaging and the addition of identifying colours/scents to colourless liquids like liquid caustic soda—rather than advances in dilation techniques alone

Prevention Checklist for Public Health Outreach

Given that accidental ingestion is the primary cause of these injuries, prevention is more effective than any medical treatment. Use this checklist for community education and caregiver awareness:

- **Safe Storage:** Always store cleaning products, detergents, and chemicals in **high, locked cabinets** out of a child's reach and sight.
- **Original Containers:** Never transfer corrosive liquids (like bleach or drain cleaner) into **food or drink containers** (e.g., water bottles or cups). Children often associate these containers with safety.
- **Child-Resistant Packaging:** Ensure all household chemicals have functioning **safety caps**. Replace caps immediately after each use.
- **Disc Battery Safety:** Keep small electronics and spare **button batteries** in secure, screw-closed compartments. A swallowed battery is a surgical emergency.
- **Immediate Action Plan:**
 - **DO NOT** induce vomiting (this re-exposes the esophagus to the caustic agent).
 - **DO NOT** attempt to "neutralize" with vinegar or lemon juice (this causes heat-producing chemical reactions).
 - **DO** seek immediate emergency medical care at a hospital with pediatric specialties.

Final Summary Statement

Caustic esophageal injuries in children are life-altering events that require a sophisticated, **multi-stage medical response**. While **early endoscopic grading** is the most critical factor for predicting outcomes, the long-term management of strictures remains a difficult journey for both the patient and the medical team. Success is not just measured by a patent esophagus, but by the child's ability to return to normal growth and psychological well-being. Until global safety regulations catch up with the risks these chemicals pose, **vigilant prevention** remains our most powerful tool.

References: -

The literature on **pediatric caustic esophageal injuries** is expansive, spanning decades of clinical experience in diagnosis, severity grading, and surgical reconstruction. Key references frequently cited in academic work are listed below by clinical category.

Core Guidelines & Classifications

- **ESPGHAN/ESGE Guidelines (2017):** Provides standards for pediatric

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gastrointestinal endoscopy, crucial for evaluating caustic ingestions.

- **Zargar et al. (1991):** Foundational study on the role of fiberoptic endoscopy in managing corrosive ingestion.
- **Uygun & Bayram (2020):** A review focusing on the management protocols of corrosive ingestion in children.

Diagnosis & Prognosis

- **Crain et al. (1984) & Gaudreault et al. (1983):** Classic studies highlighting that symptoms are not always reliable predictors of esophageal injury.
- **Poley et al. (2004) & Havanond et al. (2007):** Emphasize the importance of early endoscopy for assessing the risk of stricture development.
- **Riffat & Cheng (2009):** Analyzes 50 cases, reviewing literature on pediatric caustic ingestion.

Medical Management & Stricture Prevention

- **Contini & Scarpignato (2013):** A comprehensive review of upper gastrointestinal tract caustic injuries.
- **Doğan et al. (2006):** Analyzes 473 cases of caustic gastroesophageal lesions in children.
- **Rafeey et al. (2016) & Kay & Wyllie (2009):** Systematic review and expert review focusing on management strategies, respectively.

Stricture Treatment & Dilation

- **Poddar & Thapa (2001):** Reports on the success of Savary-Gilliard bougie dilation in treating benign strictures.
- **De Jong et al. (2001) & Zhang et al. (2013):** Evaluate long-term outcomes and endoscopic therapy in children with strictures.

Surgical Reconstruction & Long-term Care

- **Ahmed & Abu-Zaid (2003):** Details 30 years of experience with caustic esophageal strictures.
- **Chirica et al. (2012) & Orringer & Stirling (1985):** Cover surgical approaches, including colon interposition for reconstruction.

The following bibliography comprises 60 key references—ranging from seminal grading systems to modern consensus guidelines—to provide a comprehensive foundation for the study of **caustic esophageal injuries in children**.

I. Global Clinical Guidelines & Consensus Statements

Key guidelines and consensus statements for managing pediatric caustic ingestions, including endoscopy protocols, are provided by ESPGHAN/ESGE, NASPGHAN [3], and the World Society of Emergency Surgery (WSES) [2, 4]. A review of general

management strategies for acid and alkaline injuries is also available [5].

II. Foundational Pathophysiology & Grading

Early diagnostic, endoscopic, and prognostic studies of corrosive ingestion and related injuries are found in [6-8]. Key literature on predicting esophageal injury through clinical symptoms in children is provided by [9, 10]. Further analysis of the management, controversies, and spectrum of injuries from caustic ingestion is found in [11-15].

III. Modern Diagnostic & Diagnostic Modalities

Research into the role of early endoscopy for diagnosing caustic injuries is discussed in [16-18, 20-22]. Studies on the utility of endoscopic parameters, risk factors for strictures, and risk-based management algorithms are provided in [19, 23-25].

IV. Therapeutic Interventions & Pharmacology

Management strategies, including the use of corticosteroids for caustic injury, are evaluated in [26, 27]. Other treatment methods for strictures, such as stenting and medication, are found in [28-31]. Additional approaches for refractory strictures and conservative treatment of injuries in children are discussed in [32-35].

V. Endoscopic Dilation & Stricture Management

Various techniques for managing esophageal strictures, including bougie and balloon dilation, are discussed in [36-42]. The use of stents for refractory cases and their long-term applications are found in [43-45].

VI. Surgical Reconstruction & Esophageal Replacement

Approaches for managing caustic esophageal and gastric strictures through surgery are outlined in [46-48]. Techniques for esophageal reconstruction, including colonic interposition, are discussed in [49-55].

VII. Epidemiology, Long-term Outcomes & Prevention

Systematic reviews and comprehensive analyses of pediatric caustic ingestions are provided in [56-60]

The following is a comprehensive list of 60 references for caustic esophageal injuries in children, spanning seminal grading studies, international clinical guidelines, and contemporary research on management outcomes.

CONCLUSION

Caustic esophageal injuries remain a formidable challenge in pediatric medicine, necessitating a shift from purely reactive treatment to a

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holistic, **multidisciplinary framework**. While advances in endoscopic dilation and surgical reconstruction have significantly improved survival rates, the long-term **psychosocial and nutritional morbidity** remains high.

- **Multidisciplinary Care:** Successful management requires the integrated expertise of pediatric gastroenterologists, thoracic surgeons, intensivists, nutritionists, and mental health professionals to address both the physical strictures and the associated emotional trauma and social isolation.

- **The Primacy of Prevention:** As medical interventions for severe injuries are often prolonged and burdensome, **primary prevention** is the most effective strategy. Public health initiatives should prioritize:

- **Legislative Action:** Stricter regulations on the concentration of household chemicals and mandatory **child-resistant packaging**.

- **Public Education:** Raising awareness among caregivers regarding the safe storage of corrosive agents, especially in low-to-middle income countries where incidence remains high.

- **Surveillance:** Due to the exponentially increased risk of **esophageal squamous cell carcinoma**, lifelong endoscopic surveillance starting 15–20 years post-injury is mandatory for all children with high-grade burns.

In summary, while caustic ingestions are preventable, they require immediate, expert intervention when they occur to mitigate life-altering complications

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