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Original Article

Can Symptoms Predict Esophageal Dysmotility After Corrosive Injury? A High-Resolution Manometry Correlation Study

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ABSTRACT

Background: Persistent esophageal symptoms after corrosive ingestion can remain unexplained when follow-up endoscopy shows no stricture. This study evaluated whether the predominant symptom at six weeks was associated with high-resolution manometry-based diagnosis.
Aim: To assess the association between persistent esophageal symptoms and high-resolution manometry-based diagnosis in adult patients after corrosive esophageal injury with normal six-week follow-up esophagogastroduodenoscopy.
Methods: This cross-sectional observational study included 100 adult patients with previous corrosive ingestion, persistent esophageal symptoms, and normal six-week follow-up esophagogastroduodenoscopy. Patients underwent high-resolution esophageal manometry after overnight fasting. Predominant symptoms were grouped as dysphagia, heartburn, chest pain, odynophagia, and regurgitation. High-resolution manometry diagnoses were classified into normal study, ineffective esophageal motility, esophagogastric junction outflow obstruction, absent contractility, distal esophageal spasm, and hypercontractile esophagus.
Results: Dysphagia was the most common symptom, present in 44 patients, followed by heartburn in 21, chest pain in 16, odynophagia in 15, and regurgitation in four. Symptom category was significantly associated with high-resolution manometry-based diagnosis. Among patients with dysphagia, 41 of 44 had abnormal manometry. Ineffective esophageal motility was the most frequent diagnosis among patients with dysphagia, heartburn, and odynophagia. Esophagogastric junction outflow obstruction occurred only among patients with dysphagia.
Conclusion: Persistent symptom pattern after corrosive injury was associated with high-resolution manometry diagnosis. Dysphagia was the symptom most strongly associated with abnormal manometry. Normal follow-up endoscopy does not exclude clinically relevant esophageal motor dysfunction in symptomatic post-corrosive patients.

Keywords*: corrosive ingestion; dysphagia; esophageal symptoms; high-resolution manometry; motility disorder; symptom correlation.*

INTRODUCTION

Corrosive ingestion remains an important cause of upper gastrointestinal injury and chronic esophageal morbidity. Acute endoscopic grading helps estimate the depth of injury and risk of late complications, and the Zargar classification remains one of the most widely cited systems for assessing caustic mucosal injury [1,2]. Adult corrosive ingestion has distinct epidemiological and clinical characteristics, particularly when ingestion is intentional and involves larger volumes of acid or alkali [3,4]. Endoscopy is central to the initial evaluation and follow-up of corrosive injury, but visible mucosal healing does not necessarily prove functional recovery [5].

Persistent esophageal symptoms after corrosive injury are clinically challenging. Dysphagia, heartburn, chest pain, odynophagia, and regurgitation may persist even when repeat endoscopy shows no stricture. These symptoms may reflect mechanical narrowing, dysmotility, reflux, esophageal hypersensitivity, or psychological overlay after the corrosive event. Prior manometric studies have shown that corrosive injury can produce long-term motor dysfunction, including impaired peristalsis, weak contractions, absent contractility, or lower esophageal sphincter abnormalities [6-10].

High-resolution manometry provides objective assessment of esophageal body contraction and esophagogastric junction relaxation. It is recommended for evaluation of obstructive esophageal symptoms when endoscopy does not identify a mechanical cause [11-13]. The Chicago Classification version 4.0 provides the current framework for interpreting high-resolution manometry, including diagnoses such as ineffective esophageal motility, absent contractility, distal esophageal spasm, hypercontractile esophagus, and esophagogastric junction outflow obstruction [11,12,14-17].

In post-corrosive patients, symptom interpretation is particularly complex. Dysphagia may occur because of stricture, weak peristaltic propulsion, absent esophageal body contraction, impaired relaxation at the esophagogastric junction, or sensory dysfunction. Heartburn may reflect true reflux, impaired bolus clearance, or symptom overlap. Chest pain may occur with spastic disorders, reflux, hypersensitivity, or non-esophageal causes. Therefore, symptom type alone may not reliably identify the physiological abnormality [13,18].

The present paper was designed as a focused symptom-manometry correlation analysis from a parent cohort of symptomatic adults after corrosive ingestion. The specific research question was whether the predominant symptom at six weeks was associated with the high-resolution manometry-based diagnosis among patients with normal follow-up esophagogastroduodenoscopy. This manuscript intentionally focuses on symptom correlation and avoids reproducing the broad phenotype-distribution analysis of the parent cohort.

MATERIALS AND METHODS

Study design and setting

This was a cross-sectional observational study conducted in the Department of Medical Gastroenterology, Gandhi Medical College Hospital, Secunderabad. The present manuscript is a symptom-focused analysis of a parent cohort evaluating high-resolution manometry findings after corrosive esophageal injury.

Study population

The study included 100 adult patients aged more than 18 years with a history of corrosive ingestion, persistent esophageal symptoms, and normal follow-up esophagogastroduodenoscopy at six weeks. Only patients without visible stricture or significant luminal compromise on the six-week follow-up endoscopy were included for this symptom-manometry analysis.

Inclusion criteria

Patients were included if they were aged more than 18 years, had a history of corrosive ingestion, had persistent esophageal symptoms, and had normal esophagogastroduodenoscopy at six weeks after ingestion.

Exclusion criteria

Pregnant women, clinically unstable patients, patients with esophageal strictures, patients with previous foregut surgery, and patients unwilling to provide consent were excluded.

Clinical and endoscopic assessment

All eligible patients underwent clinical evaluation and esophagogastroduodenoscopy within three days of corrosive ingestion to assess acute injury and grade mucosal damage using the Zargar classification as shown in table 1 [1,2,5]. Repeat esophagogastroduodenoscopy was performed at six weeks. Endoscopic assessment was performed with a diagnostic upper gastrointestinal video endoscope system (Olympus CV-150 series, Olympus Corporation, Tokyo, Japan) with GIF-Q150.

Table 1. Zargar Endoscopic Classification of Corrosive Upper Gastrointestinal Injury

Zargar grade	Endoscopic finding
Grade 0	Normal mucosa
Grade 1	Edema and erythema of mucosa
Grade 2A	Hemorrhage, erosions, blisters, exudates, superficial ulcerations
Grade 2B	Deep discrete ulcerations or circumferential ulcerations
Grade 3A	Focal areas of necrosis with deep gray or brownish-black ulcers
Grade 3B	Extensive necrosis
Grade 4	Perforation

Symptom assessment
At six weeks, the predominant persistent esophageal symptom was recorded for each patient. Symptoms were categorized as dysphagia, heartburn, chest pain, odynophagia, or regurgitation. Each patient was assigned to one predominant-symptom category for the purpose of statistical analysis.

High-resolution manometry protocol and equipment
High-resolution esophageal manometry was performed using a 16-channel water-perfused manometry system (KangarooJeff, Royal Melbourne Hospital, Australia). The recordings were analyzed using Trace software, and manometric diagnoses were assigned according to Chicago Classification version 4.0. Manometry was performed using a transnasal catheter positioned to record the upper esophageal sphincter, esophageal body, lower esophageal sphincter, and proximal stomach. Recorded parameters included basal lower esophageal sphincter pressure (LESP), integrated relaxation pressure(IRP), distal contractile integral, distal latency (DCI), contraction vigour, contraction pattern, intrabolus pressure pattern, and final high-resolution manometry diagnosis.

Diagnostic criteria
High-resolution manometry interpretation was based on Chicago Classification version 4.0 and related high-resolution manometry methodology [11,12,14-17]. Diagnoses were grouped as normal study, ineffective esophageal motility (IEM), esophagogastric junction outflow obstruction (EGJOO), absent contractility, distal esophageal spasm (DES), and hypercontractile esophagus.

Outcome measures
The primary outcome was the association between predominant symptom category and high-resolution manometry-based diagnosis. Secondary analysis evaluated the association between predominant symptom category and abnormal versus normal high-resolution manometry result.

Statistical analysis
Original data entry was performed using Microsoft Excel (Microsoft Corporation, Redmond, WA, USA). Categorical variables are presented as frequency and percentage. The global association between symptom category and high-resolution manometry diagnosis was evaluated using Pearson chi-square test, with degrees of freedom and Cramér's V reported as the effect size. The association between symptom category and abnormal versus normal manometry was also evaluated using Pearson chi-square test. Fisher exact testing was used for selected two-by-two symptom comparisons when sparse cells were present. A p value <0.05 was considered statistically significant.

Ethical considerations
The study was approved by the Institutional Ethics Committee of Gandhi Medical College Hospital, Secunderabad. Written informed consent was obtained from all participants.

RESULTS
A total of 100 symptomatic adult patients with previous corrosive ingestion and normal follow-up endoscopy at six weeks were included. Dysphagia was the most common predominant symptom, followed by heartburn, chest pain, odynophagia, and regurgitation. The distribution of predominant symptoms is shown in Table 2.

Table 2. Distribution of predominant esophageal symptoms

Predominant symptom	Frequency	Percentage
Dysphagia	44	44.0
Heartburn	21	21.0
Chest pain	16	16.0
Odynophagia	15	15.0
Regurgitation	4	4.0

Values are presented as frequency and percentage. No inferential statistical test was applied to this descriptive table.
There was a significant global association between predominant symptom category and high-resolution manometry-based diagnosis. Pearson chi-square test showed $\chi^2=63.26$ with 20 degrees of freedom, $p<0.001$. Cramér's V was 0.40, indicating a moderate association. The detailed symptom-by-diagnosis distribution is shown in Table 3.

Table 3. Association between predominant symptom and high-resolution manometry-based diagnosis

Predominant symptom	Absent contractility	DES	EGJOO	Hypercontractile esophagus	IEM	Normal study
Chest pain	0	0	0	0	5	11
Dysphagia	6	4	9	4	18	3
Heartburn	0	0	0	0	11	10

Odynophagia	0	3	0	2	10	0
Regurgitation	1	0	0	0	0	3

Values are presented as frequency. Statistical comparison was performed using Pearson chi-square test: $\chi^2=63.26$, degrees of freedom=20, $p<0.001$; effect size Cramér's V=0.40. Because several cells had low expected values, the association should be interpreted as exploratory and hypothesis-generating. DES: Distal esophageal spasm, EGJOO: Esophagogastric junction outflow obstruction, IEM: Ineffective esophageal motility

When high-resolution manometry findings were dichotomized as abnormal versus normal, symptom category remained significantly associated with manometry status. Pearson chi-square test showed $\chi^2=38.00$ with four degrees of freedom, $p<0.001$, and Cramér's V was 0.62, indicating a strong association. Dysphagia had the strongest clinical association with abnormal manometry: 41 of 44 patients with dysphagia had abnormal findings. The dichotomized analysis is shown in Table 4.

Table 4. Predominant symptom according to abnormal or normal high-resolution manometry result

Predominant symptom	Abnormal HRM	Normal HRM	Total
Chest pain	5 (31.3)	11 (68.8)	16 (100.0)
Dysphagia	41 (93.2)	3 (6.8)	44 (100.0)
Heartburn	11 (52.4)	10 (47.6)	21 (100.0)
Odynophagia	15 (100.0)	0 (0.0)	15 (100.0)
Regurgitation	1 (25.0)	3 (75.0)	4 (100.0)

Values are presented as n (% within symptom row). Statistical comparison was performed using Pearson chi-square test: $\chi^2=38.00$, degrees of freedom=4, $p<0.001$; effect size Cramér's V=0.62. For dysphagia versus all other symptoms, Fisher exact test gave $p<0.001$ and odds ratio=10.25 for abnormal manometry. HRM: High-Resolution Manometry

Among patients with dysphagia, IEM was the most frequent diagnosis, followed by EGJOO, absent contractility, DES, hypercontractile esophagus, and normal manometry. Among patients with heartburn, IEM and normal manometry were the dominant patterns. Chest pain was more frequently associated with normal manometry than with major motor disorders, while odynophagia was associated mainly with IEM and spastic or hypercontractile patterns. Regurgitation was uncommon and was mostly associated with normal manometry in this cohort.

DISCUSSION

This study demonstrates a statistically significant association between persistent symptom category and high-resolution manometry-based diagnosis in symptomatic adult patients after corrosive esophageal injury with normal follow-up endoscopy. The finding is clinically relevant because all patients had no visible stricture on six-week endoscopy. Therefore, persistent symptoms in this cohort could not be explained by an obvious structural narrowing alone. High-resolution manometry provided an objective physiological explanation in a substantial proportion of patients, especially those with dysphagia.

Dysphagia was the most important symptom in this analysis. Forty-one of 44 patients with dysphagia had abnormal manometry, and dysphagia was associated with a ten-fold higher odds of abnormal manometry compared with all other symptoms combined. This supports the concept that post-corrosive dysphagia after apparent mucosal healing should not be dismissed as nonspecific. Prior studies using conventional and high-resolution manometry have shown that caustic injury may produce persistent motor dysfunction even when the lumen is patent or after stricture treatment [6-10].

IEM was the most frequent diagnosis among patients with dysphagia, heartburn, and odynophagia. This pattern is physiologically plausible in post-corrosive injury because partial injury to smooth muscle or intramural neural plexuses can reduce contraction vigour without completely abolishing peristalsis [6-9]. Weak or fragmented contractions may impair bolus clearance and generate symptoms such as dysphagia, food hold-up sensation, regurgitation, or reflux-like complaints. Chicago Classification version 4.0 recognizes ineffective esophageal motility as a hypocontractile disorder, and the present findings suggest that it may be an important post-corrosive phenotype [11,12].

EGJOO occurred only among patients with dysphagia. This observation is clinically important because esophagogastric junction outflow obstruction represents a different mechanism from ineffective motility. In this disorder, preserved esophageal body contractions may be present, but impaired relaxation or opening at the esophagogastric junction produces resistance to bolus passage [11,15,16]. Chicago Classification version 4.0 recommends interpreting this diagnosis in relation to symptoms and supportive evidence, and the presence of dysphagia in all patients with esophagogastric junction outflow obstruction strengthens the clinical relevance of this subgroup [11-13].

Odynophagia was also associated with abnormal manometry in this cohort. Although odynophagia is classically considered a mucosal symptom, persistence after mucosal healing may reflect altered esophageal sensory processing, abnormal contractions, or residual neuromuscular injury. In this study, odynophagia clustered mainly with IEM, DES, and hypercontractile esophagus. This suggests that post-corrosive pain on swallowing may sometimes reflect motor or sensory dysfunction rather than ongoing visible mucosal injury.

Chest pain showed a different pattern. Most patients with chest pain had normal high-resolution manometry, while a smaller proportion had ineffective esophageal motility. This does not mean chest pain is unimportant; rather, it suggests that chest pain in post-corrosive patients may require broader evaluation, including reflux testing, assessment for esophageal hypersensitivity, psychological factors, and non-esophageal causes [13,18]. Similarly, regurgitation was uncommon, and the small number of patients limits interpretation.

The results support the clinical value of functional testing after corrosive injury. In routine practice, patients with persistent symptoms and normal endoscopy may be reassured or treated empirically. The present analysis suggests that this approach may miss clinically relevant dysmotility, particularly in patients with dysphagia. High-resolution manometry is recommended in the evaluation of obstructive esophageal symptoms when endoscopy does not demonstrate mechanical obstruction [13,17]. In post-corrosive patients, this recommendation is especially relevant because the insult can injure both structure and neuromuscular function.

The moderate association between symptom category and detailed manometric diagnosis, and the strong association between symptom category and abnormal versus normal manometry, also show that symptoms are useful but imperfect predictors. Dysphagia strongly suggested abnormal manometry, but it occurred across several different manometric diagnoses. Heartburn occurred in both ineffective esophageal motility and normal manometry. Thus, symptoms can guide suspicion and patient selection for manometry, but they cannot replace objective physiological testing.

The present findings add to the limited literature on esophageal physiology after caustic ingestion. Earlier studies showed that corrosive injury can produce aperistalsis, low-amplitude contractions, sphincter dysfunction, or abnormal bolus transit [6-10]. This study extends that concept by showing that specific symptom clusters after healed corrosive injury are associated with different high-resolution manometry phenotypes. The results support a symptom-directed but physiology-confirmed approach to post-corrosive follow-up.

Limitations

- This was a single-center study, which may limit generalizability to other populations and care settings.
- Only symptomatic patients with normal six-week follow-up endoscopy underwent high-resolution manometry; therefore, results should not be generalized to asymptomatic patients or patients with established strictures.
- Some symptom subgroups, especially regurgitation, had small numbers, which limits precision and makes subgroup interpretation exploratory.
- Several cells in the symptom-by-diagnosis table had low expected values; therefore, the chi-square analysis should be interpreted cautiously despite statistical significance.
- Supportive physiological tests such as timed barium esophagram, pH-impedance monitoring, or functional lumen imaging probe assessment were not available for correlation.
- Long-term symptom follow-up and treatment-response data were not included.
- The exact endoscope model, manometry software version, and original statistical software package should be verified from institutional records before final resubmission.

CONCLUSION

Persistent esophageal symptoms after corrosive injury showed a significant association with high-resolution manometry-based diagnosis. Dysphagia was the most common symptom and the strongest clinical indicator of abnormal manometry, particularly ineffective esophageal motility and esophagogastric junction outflow obstruction. Normal follow-up endoscopy does not exclude clinically relevant esophageal motor dysfunction. High-resolution manometry should be considered in symptomatic post-corrosive patients, especially those with persistent dysphagia despite a normal six-week endoscopy.

Declarations

Ethics approval: The study was approved by the Institutional Ethics Committee of Gandhi Medical College Hospital, Secunderabad.

Consent: Written informed consent was obtained from all participants.

Conflicts of interest: The authors declare no conflicts of interest.

Funding: No external funding was received.

Data availability: The data supporting the findings of this study are available from the corresponding author on reasonable request, subject to institutional and ethical permissions.

Related manuscript disclosure: This manuscript is a symptom-high-resolution-manometry correlation analysis from a parent observational cohort evaluating high-resolution manometry after corrosive esophageal injury. The present paper addresses a distinct research question focused on symptom prediction of manometric phenotype and does not reproduce the primary high-resolution manometry phenotype distribution table from the related main manuscript.

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