

# Esophageal Achalasia Following Lye Ingestion

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MOTILITY disturbances associated with caustic injury to the esophagus have received little attention in spite of abundant documentation of the treatment and late sequela of this disease.<sup>1, 10</sup> This is surprising since the gradual formation of stricture in these patients provides an unusual clinical model for studying the pathophysiology of acquired esophageal dysfunction. In the present study, esophageal motility was assessed in five patients by radiography and manometry at varying intervals following the ingestion of lye. Motility patterns comparable to those found in achalasia<sup>3</sup> were unexpected findings which form the basis for this report.

## Material and Methods

Five patients whose ages range from 3 to 48 years, presented with a history of lye ingestion 3 hours to 4 months prior to admission to the University of Alabama Medical Center. Evaluations included esophagoscopy at some point during the period of observation. Thirteen esophageal motility studies were obtained, four at intervals on one patient. Esophageal motility was recorded by open tip and balloon manometry as previously described.<sup>5</sup> Pressure responses were recorded in the lower esophageal sphincter, body of the esophagus and pharyngoesophageal sphincter, both at rest and following deglutition. These studies were well tolerated even during the acute phase of caustic esophageal injury.

## Case Reports

**Case 1.** (SO—E 09 75 37) A 48-year-old woman entered the University of Alabama Medical Center on 7/22/67, four days following the ingestion of a half glass of lye. During this 4-day period, she developed progressive inability to swallow either solids, liquids or her saliva. Examination of the oral pharynx showed extensive burns. Esophagoscopy was not performed at this time. The patient was given parenteral fluids and 800,000 units of procaine penicillin and 0.5 Gm. of Chloromycetin® every 6 hours. A number 12 French nasogastric tube was inserted on the second day and tube feedings were initiated. Five days following admission progressive dilatations with mercury weighted bougies were started so that by 10 days she was able to tolerate a soft diet. While barium swallow x-rays at that time showed a normal appearing esophagus (Fig. 1), manometry revealed low resting pressures and a poor response to swallowing within the lower esophageal sphincter (Figs. 2, 3). High resting pressures and simultaneous and repetitive contractions were demonstrated within the body of the esophagus (Fig. 4).

She was discharged to be followed as an outpatient, but failed to keep her appointment. Two months later she was seen in the Emergency Room with nearly complete stenosis of her hypopharynx. Tracheostomy and gastrostomy were performed. She was discharged taking feedings per gastrostomy tube to improve nutrition.

Retrograde esophagoscopy 2 months later disclosed a stricture in the midaspect of the esophagus; the cervical esophagus could not be entered. A laryngo-fissure was performed on 5/30/68. The epiglottis which was intimately bound to the area of the arytenoids was excised. It was possible at this time to pass a string through the cervical esophagus and progressive dilatations were started. While the patient has been able to swallow saliva without difficulty, she has not been able to ingest oral alimentation. She is presently awaiting a reconstructive procedure for pharyngeal stenosis.

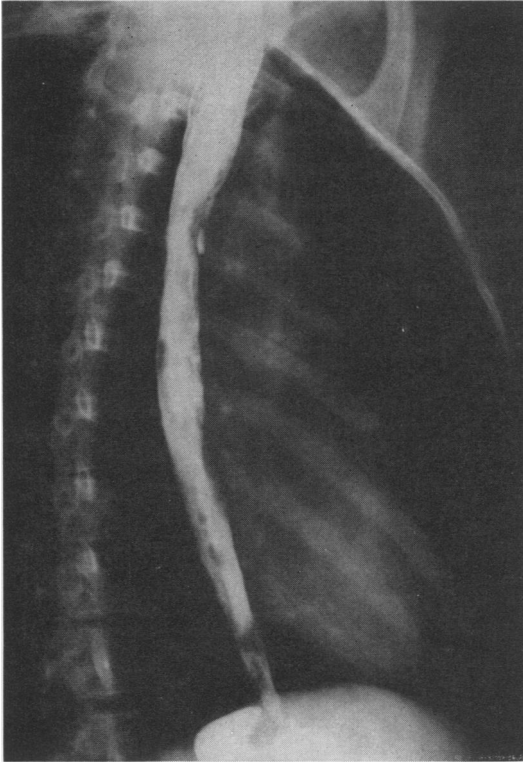


FIG. 1. (Case 1) Normal barium esophagram 10 days following lye ingestion.

**Case 2.** (AC—E 12 94 78) A 30-month-old boy was admitted to the University of Alabama Medical Center on 10/8/65 following ingestion of a half a teaspoon of lye. He received a glass of milk immediately after injury, and vaseline was placed on his oral burns.

Upon admission he had difficulty in swallowing; a gastrostomy was performed. He was never able to maintain adequate oral nutrition in spite

of multiple dilatations over the ensuing 2 years. At 4 years of age he was a small, well proportioned boy whose weight was 25.8 pounds and height 35 inches. At 4½ years of age his weight had increased to 30 pounds and he had grown an additional inch. Figure 5 represents an esophagram taken at this time. Motility studies were similar to those described in the previous case except that response of the lower esophageal sphincter was normal.

Because of inability to tolerate multiple dilatations and maintain adequate oral alimentation, esophagectomy with interposition of the left colon between the cervical and distal esophagus was performed on 8/13/67. Figure 6 is a representative histologic section of his esophagus which reveals marked fibrosis of the esophageal wall. There is, in addition, a profound disruption of the ganglion cells within Auerbach's plexus. Subsequent recovery was unremarkable.

**Case 3.** (SL—E 15 71 66) A 21-year-old woman ingested a glass of lye on November 1, 1966. She underwent gastric lavage at a local hospital and was given a liquid diet and progressed to solid foods. Over the ensuing several days, however, she developed progressive inability to feed herself, and was referred to the University of Alabama Medical Center on 12/19/67. Barium swallow x-rays at that time showed marked esophageal narrowing and gastric dilatation (Fig. 7a). Hemigastrectomy, gastrostomy, and retrograde esophageal dilatation to a 36 French size were performed without difficulty. The gastric antrum was completely obliterated by cicatricial stenosis three centimeters from the gastro-duodenal junction. Recovery was uneventful, but over the following 8 months she required three hospitalizations for restenosis of the esophagus. Barium swallow x-rays at 3 and 8 months are demonstrated in Figures 7b and 7c, respectively.

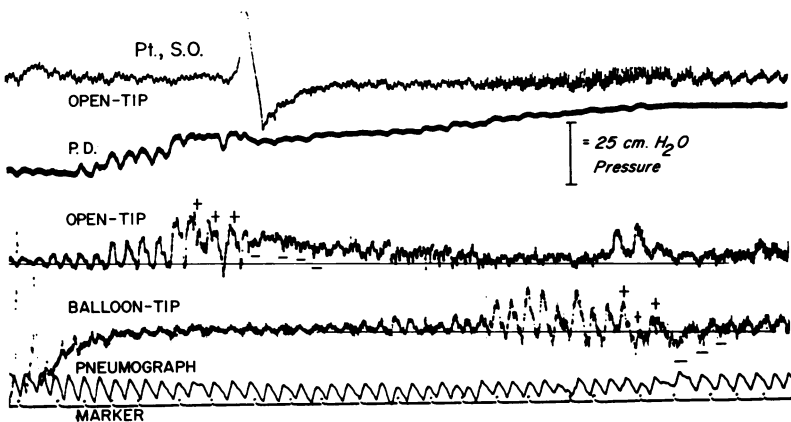
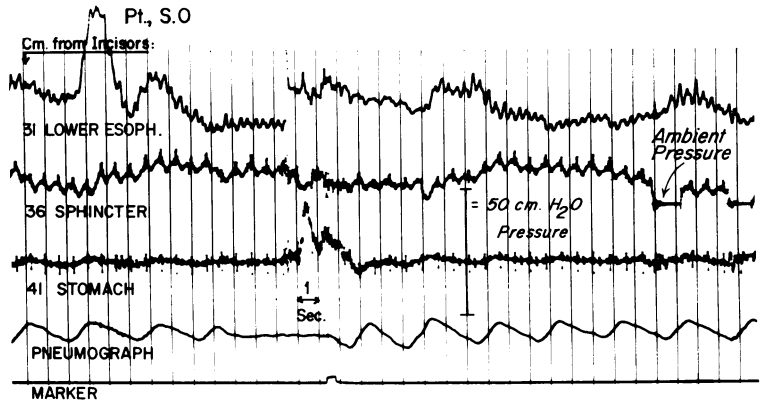


FIG. 2. (Case 1) Resting pressure profile of the gastroesophageal junction 10 days following lye ingestion. Pressures are low by balloon, but only slightly so by the open tip detector.

FIG. 3. (Case 1) Response of the lower esophageal sphincter demonstrating relaxation after deglutition but feeble sphincter contractions. The latter responses occurred in a peristaltic sequence with the lower esophageal contractions.



Motility studies on four occasions revealed high resting pressures within the body of the esophagus, and simultaneous repetitive contractions on deglutition (Fig. 8). Right colon interposition between cervical esophagus and stomach was performed on 9/17/67. Postoperative recovery was uneventful.

Over the ensuing 2 months she gained 20 pounds. Figure 7d shows the colon interposition at that time. Motility study revealed that the colon did not respond to deglutition, but had intrinsic motility (Type II waves). Even though she maintained good nutrition, she had discomfort with swallowing similar to that which she had prior to colon interposition. Barium swallow x-rays showed the interposition intact; esophagoscopy also revealed that there was no stenosis. It was surmised that symptoms were due to stimulation of motor responses of the retained esophagus. Accordingly, on 6/3/68 the esophagus was removed. The specimen showed marked stricture of the lower two-thirds of the esophagus as on previous x-rays. At the junction of the upper and middle thirds of the esophagus, the lumen was completely stenotic; the proximal esophageal pouch was markedly dilated. Histologic examination of the esophagus showed extensive scarring of both the mucosal and muscle layers of the mid-esophagus, and disruption of Auerbach's plexus (Fig. 9). Recovery postesophagectomy has been unremarkable and symptoms of dysphagia have been absent for 6 months following this procedure.

**Case 4.** (SLD—E 12 56 35) A 28-year-old woman entered the University of Alabama Medical Center on 8/16/65, four months following the ingestion of an undetermined amount of lye. She was slender and well appearing and had maintained nutrition during this period by gastrostomy. In the oral cavity there was an 0.5 centimeter opening in the hypopharynx. The epiglottis was

bound to the posterior pharyngeal wall. An anterior pharyngotomy with epiglotectomy was performed on 10/15/65.

Esophageal dilations were performed at 3 to 6-month intervals over the next 2 years. The area of stricture which required repeated dilations is shown in barium swallow x-rays in Figure 10. Esophageal motility study on 9/13/67 showed feeble contractions within the lower esophageal sphincter and lower esophagus. Resting pressures within the body of the esophagus were elevated, and following deglutition the contractions were simultaneous and occasionally repetitive. These changes are demonstrated in Figure 11. Motility study 2 months later showed that the lower esophageal sphincter had normal resting pressures which were stronger than previously recorded, and that the contractions within the body of the esophagus were approaching normal.

**Case 5.** (GA—E 17 31 17) An 18-year-old woman came to the Emergency Department of the University of Alabama Medical Center 3 hours

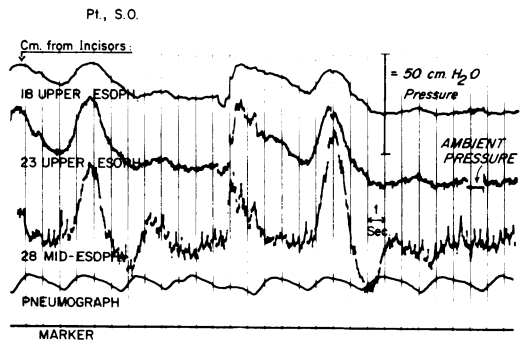


FIG. 4. (Case 1) Resting pressures within the body of the esophagus are above ambient (Figs. 2, 3). Swallowing responses are simultaneous and repetitive.



FIG. 5. (Case 2) Barium esophagram 22 months following lye ingestion reveals a long area of stricture within the body of the esophagus.

following the ingestion of a handful of lye with extensive burns of the tongue, lips, and pharynx. Esophagoscopy demonstrated the pharynx and upper esophagus to be erythematous and moist with edema fluid. The lower esophagus appeared normal.

Early therapy consisted of 100 mg. of Solu-Cortef® every 8 hours, 600,000 units of penicillin four times a day, and 2 Gm. of Chloromycetin® each 24 hours. Dilatations were started on the following day with mercury weighted bougies. These were progressed to a size 44 French dilator without difficulty over a 2-day period. Esophageal motility recorded on the ninth day following hospitalization demonstrated high resting pressures in the body of the esophagus with no response to deglutition. Low pressures were recorded within the lower esophageal sphincter following deglutition. In spite of this profound disturbance in esophageal motility, barium swallow x-rays were normal. She was asymptomatic by the fourteenth hospital day and was discharged taking a soft diet; steroids and antibiotics were discontinued.

At follow-up motility studies 8 months following injury there was difficulty in passing the sensing units beyond eighteen centimeters from

the upper incisor teeth. Motility in the upper esophagus following a swallow was normal except for occasional simultaneous contractions. Cine-fluorogram on the same day showed normal passage of barium through the esophagus without stricture. The patient continues to have mild dysphagia, especially to solids, but has not continued the dilatations. She is being followed for possible late stricture.

## Results

Table 1 compares pressures at the gastro-esophageal junction in normal or healthy individuals with similar pressures in patients with lye injury of the esophagus. Resting pressures which were 9.4 by open tip and 23.4 by balloon at end-inspiration were not markedly different from those found in healthy controls. However, pressure response of the lower esophageal sphincter to deglutition was approximately half that in normal volunteers.<sup>5</sup> The overall qualitative manometric findings are compared in Table 2. Each motility tracing demonstrated at least two similar manometric findings, namely, motor incoordination and elevated resting esophageal pressures. The type and degree of abnormal motility, however, varied from patient to patient. This variability may be explained by the amount of lye ingested, the extent of the esophagus involved, and the period of time lapse between lye ingestion and testing.

The motor incoordination found in the body of the esophagus consisted primarily of a loss of the usual peristaltic sequence. This motor incoordination was depicted by simultaneous and occasional repetitive contractions which replaced the peristaltic sequence observed in the body of the normal esophagus. At times, contractions were of normal amplitude. In a few instances, feeble responses occurred; a paralyzed esophagus was found in two patients (Cases 3 and 5). Some of the swallowing responses were bizarre, having double peaks as observed in Figure 11.

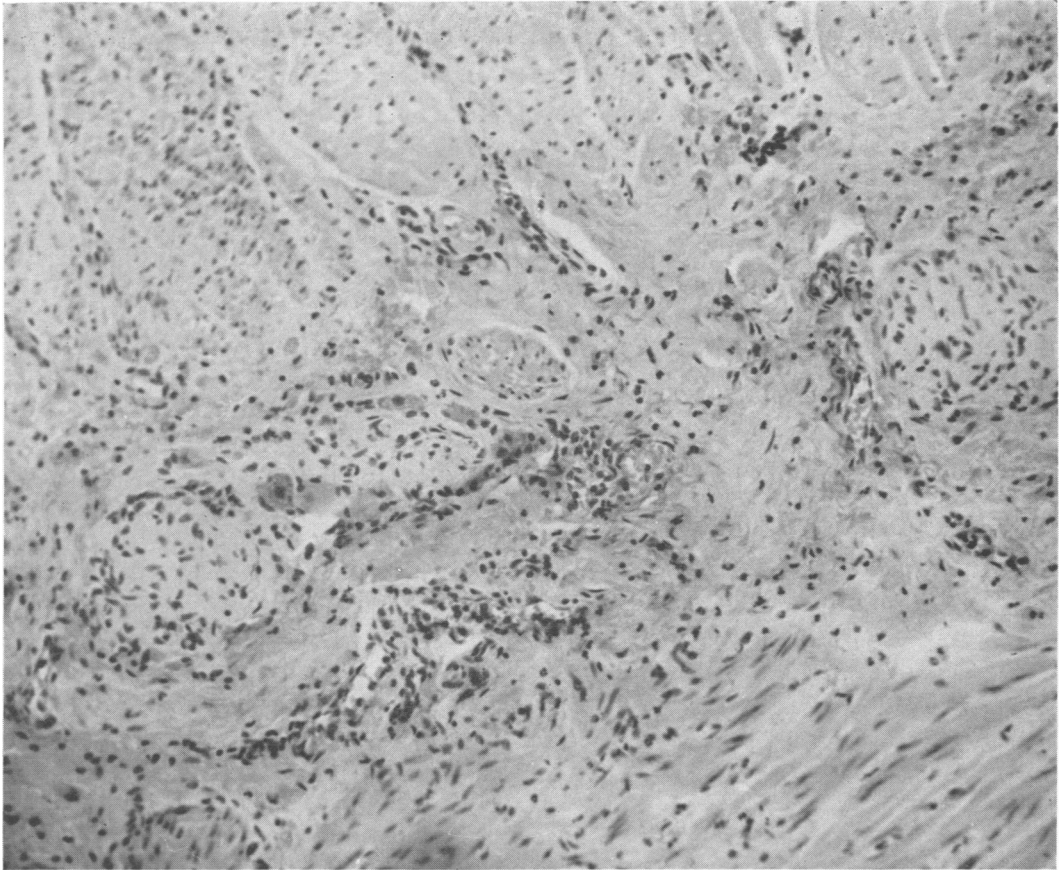


FIG. 6. (Case 2) Photomicrograph (80 $\times$ ) showing the region of Auerbach's plexus between the longitudinal and circular muscle layers of the mid-esophagus. The disruption in continuity of the ganglion cells by fibrous tissue is accompanied by an infiltrate of small round cells.

In each case, resting esophageal pressures were elevated to at least some degree. In two patients (Cases 2 and 3) the elevation was marked, being greater than atmospheric. The remaining three patients had pressures equal to ambient which indicated only slight elevation of pressure. One patient had high resting pressures throughout the esophagus, while in the other four, pressure elevations were localized in the narrowed regions seen on barium esophagrams.

#### Discussion

Moderate to severe caustic injury to the esophagus is followed by gradual scarring and stricture formation in a high percentage

of cases.<sup>11</sup> Four patients in the present study responded to lye ingestion in this manner. All patients, including one who did not progress to stricture, demonstrated high resting pressures and simultaneous, repetitive contractions within the body of the esophagus. In three patients barium swallow x-rays did not demonstrate a significant degree of esophageal obstruction at a time when profound motility disturbances were observed by manometry. This discrepancy between assessment of esophageal function by radiographic and manometric methods has previously been recorded<sup>7</sup> and is related in part to the fact that liquids traverse the esophagus primarily by gravity and do not require peristaltic contractions.

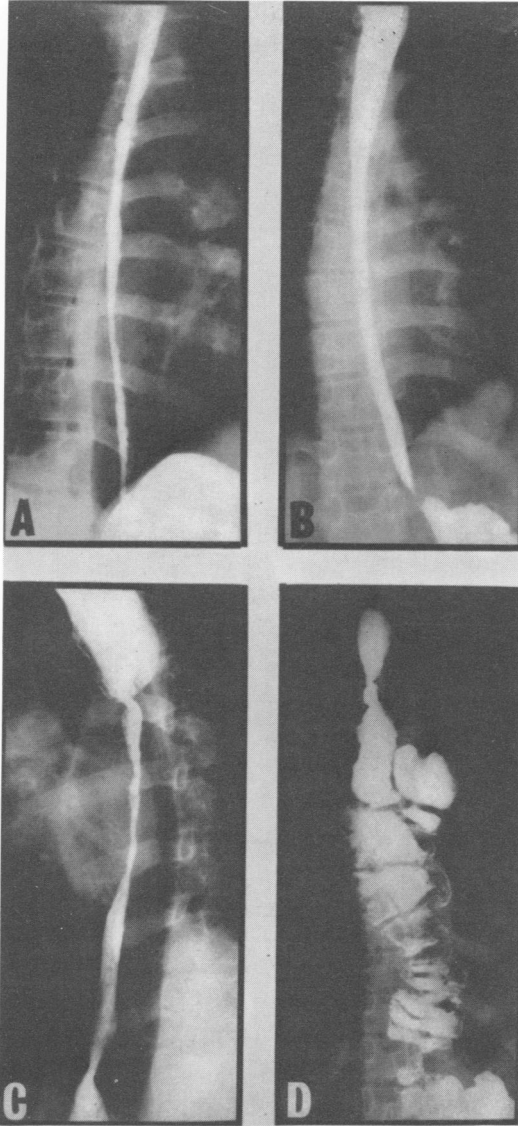
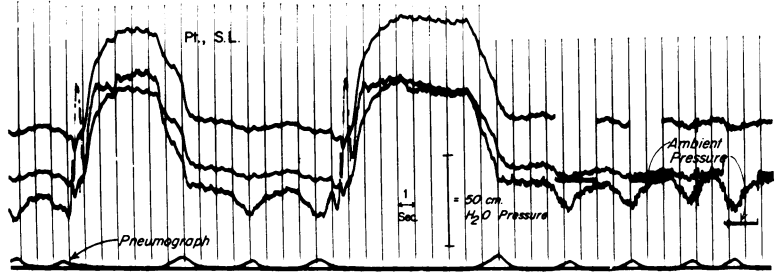


FIG. 7. (Case 3) 7a. Barium esophagram 7 weeks after lye ingestion demonstrates marked generalized narrowing of the esophagus. The fundus of the stomach is markedly distended with barium as a consequence of complete stenosis of the gastric antrum. (Case 3) 7b. Appearance of esophagus by barium swallow following one month of daily dilatations by mercury weighted bougies. (Case 3) 7c. Barium esophagram at 8 months reveals progressive stenosis of the lower two-thirds of the esophagus. (Case 3) 7d. Barium study of the cervical esophagus and interposed right colon 2 months following surgery. In spite of an apparent area of narrowing at the anastomosis, patient was without symptoms, and had gained 20 pounds in weight.

To some extent these abnormal manometric patterns are seen in well recognized disturbances of the esophagus and may be explained by one or more underlying patho-physiologic states. Mucosal irritation, as in reflux esophagitis, has been shown by Olsen and Schlegel<sup>12</sup> to produce motor incoordination and in a few severe lesions, paralysis of the esophagus. No mention was made by Olsen of elevated resting esophageal pressures; patients, however, with obstruction secondary to stricture were excluded from his study. Kelley demonstrated similar manometric findings associated with obstruction from benign stricture and carcinoma.<sup>7, 8</sup> Recently, Kolodny and co-workers observed achalasia-like motility patterns in a patient with carcinoma of the proximal stomach which involved the lower esophageal musculature.<sup>9</sup> In this case, the myenteric plexus was extensively disrupted by neoplastic cells. While patients with diffuse esophageal spasm also have a severe form of motor incoordination,<sup>4</sup> they lack elevated resting esophageal pressures which distinguish them from patients with achalasia or lye stricture as observed in the present study.

Histologic sections from two cases requiring resection may explain, in part, motility disturbances observed. Early after lye ingestion, while injury is acute and possibly superficial, mucosal damage may simulate reflux esophagitis and account for the simultaneous, feeble and occasional repetitive contractions. Early disruption of neuromuscular transmission must also be considered, since manometric disturbances were present in two patients shortly after lye ingestion at a time when barium esophagram was normal. Vigorous, simultaneous, and repetitive contractions may be explained on the basis of obstruction from scarring and stricture formation in the more advanced cases. In fact, the entire thickness of the esophagus was involved in the two specimens available for study. It is

FIG. 8. (Case 3) Motility tracing demonstrating simultaneous and prolonged contractions within the body of the esophagus several months after lye ingestion. There is marked elevation of resting esophageal pressure.



also conceivable that the vagus nerves may have been injured in their course just outside the esophageal wall. Microscopic sections of these nerves were not obtained. Extensive histologic studies by Cassella *et al.* show that the vagus nerves, myenteric

plexus, and esophageal musculature may all be pathologic in achalasia.<sup>2</sup>

It is difficult to explain the elevated resting esophageal pressures observed in this study. There was no radiographic or endoscopic evidence of food retention within

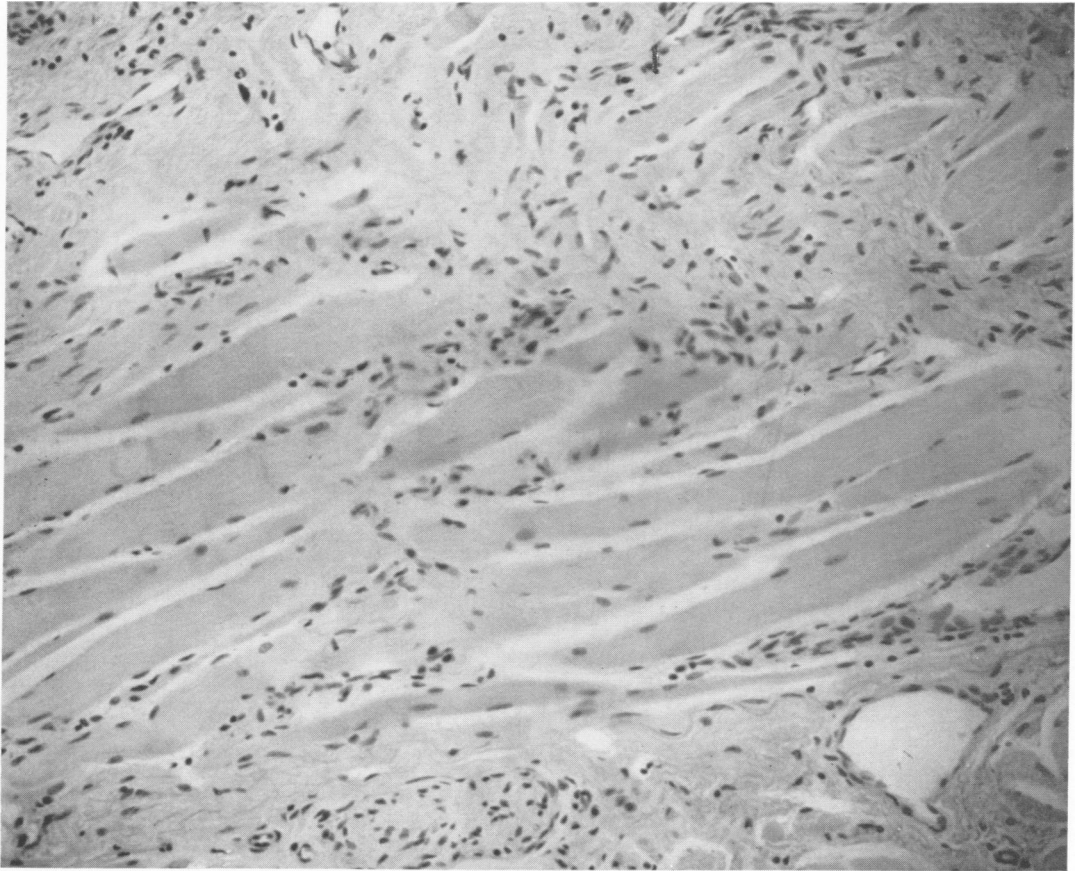


FIG. 9. (Case 3) Photomicrograph (80 $\times$ ) of a histologic section taken at the mid-esophagus, demonstrates partial replacement of the circular smooth muscle layer by fibrous tissue.



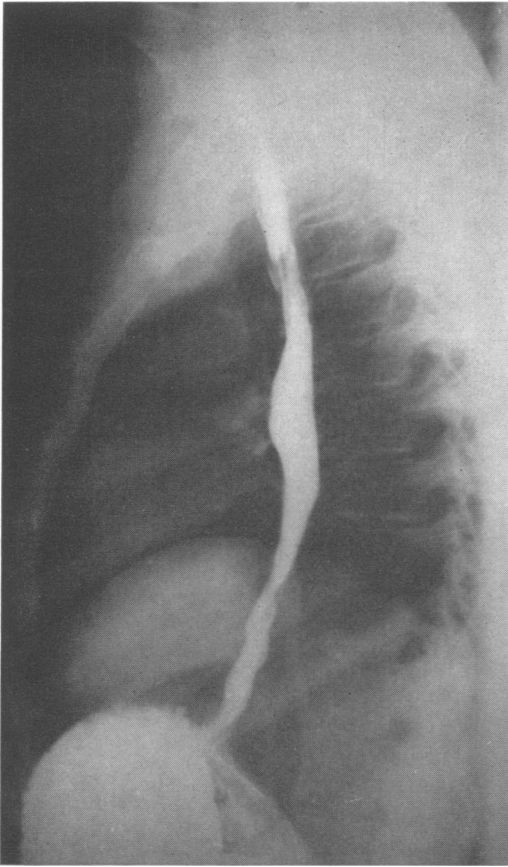


FIG. 10. (Case 4) Barium esophagram 2 years following lye ingestion, reveals moderate narrowing of the lower esophagus. Patient was only mildly symptomatic at that time.

the esophagus. The presence of retention has been used to explain elevated resting pressures in achalasia.<sup>3,7</sup> The fact that the

lower esophageal sphincter was involved in only three instances, is consistent with the general observation that lye injury is usually more pronounced in the body of the esophagus.

The clinical management of this heterogeneous group of patients included a variety of supportive, manipulative, and surgical approaches, all of which have been described previously.<sup>1, 10, 11</sup> The number of cases reported here are too few to confirm or deny the beneficial effects of steroid therapy or early bougienage or both. Worthy of comment is the operative approach to patients with far advanced stenotic lesions. The younger patient was treated with repeated bougienage for 2 years with progressive difficulty. Interposition of the left colon between the cervical and lower esophagus completely relieved his dysphagia. Operation was withheld until further dilatations had become impossible without general anesthesia. The reluctance to employ surgical replacement of the esophagus was based upon a concern that this would not insure a good result. In retrospect, this delay imposed considerable hardship upon the patient. Examination of the excised esophagus emphasized the hopelessness of persistent bougienage in attempt to overcome the stricture. That chronic bougienage, however, can lead to complete restoration of esophageal function, has been documented in the literature.<sup>6</sup>

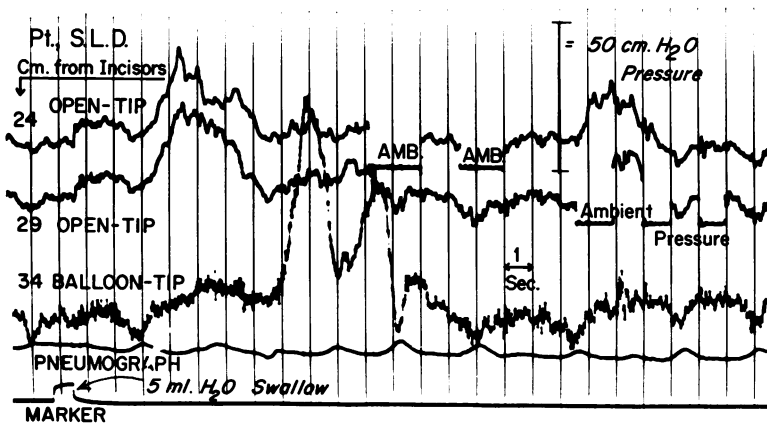


FIG. 11. (Case 4) Swallowing responses detected by open and balloon tip detectors in the mid and lower esophagus. A water swallow produced simultaneous contractions and a double peaked contraction detected by open tip and balloon detectors, respectively. Resting esophageal pressures exceed ambient.



TABLE 1. *Swallowing Response of the Pharynx and Esophagus and Its Sphincters\**

	Health	Stricture
Gastroesophageal sphincter	25.0 ± 5.0	14.8 ± 6.1
Low esophagus	73.1 ± 8.5	29.6 ± 11.0
Mid esophagus	62.6 ± 8.2	29.0 ± 9.2
Upper esophagus	61.2 ± 8.3	24.8 ± 10.5
Pharyngo-esophageal sphincter	79.0 ± 3.3	37.8 ± 5.3
Pharynx	79.4 ± 3.3	40.0 ± 8.3

Resting pressure at the esophago-gastric junction equals 9.4 ± 2.7 by open tip, and 23.4 ± 5.9 by balloon at end-inspiration.

\* Values are in centimeters of H<sub>2</sub>O ± the standard deviation.

Patient four (SLD) in the series remained symptom free for 9 months after undergoing twenty dilatations over a 3-year period. Bougienage, however, was unsuccessful in Case 2 (SL). In fact, symptoms of dysphagia persisted after right colon interposition. Since esophagectomy provided complete relief of symptoms, it is presumed that persistence of dysphagia was related to motility within the markedly stenotic residual esophagus.

Manometric studies of the esophagus appear to be of some prognostic value following caustic injury. This was reflected in two patients (Cases 1 and 5) in whom marked motor incoordination accompanied a normal barium swallow. Severe stricture formation of the hypopharynx and mid-esophagus subsequently developed in one, and moderate incoordination of the upper esophagus has been accompanied by gradual development of mild dysphagia in the other. Since esophageal motility is a safe and convenient way to assess function, it might be valuable for determining whether, in fact, lye ingestion lead to esophageal injury. In the present studies we employed early esophagoscopy whenever possible to correlate the value of manometric and radiographic assessment of the extent of injury. While there has been some concern about early esophagoscopy examination, this provides the most direct way for assessing the extent of injury within the esophagus.

TABLE 2. *Esophageal Manometric Determinations in Patients after Lye Ingestion*

Case No.	Gastroesophageal Sphincter		Esophagus				Pharynx		
	Resting Pressure	Swallowing Response Relaxation-Contraction	Resting Pressure	Swallowing Response	Swallowing Response	Resting Pressure	Swallowing Response	Resting Pressure	Swallowing Response
			Lower	Middle	Upper	Lower	Middle	Upper	
1 (SO)	Low	Yes	Ambient*	Ambient	Ambient	Weak	Weak	Normal	Weak
2 (AC)	Normal	Yes	Normal	Ambient	Elevated	Weak	Weak	Weak	Normal
3 (SL)	Very low	No†	Normal	Ambient	Elevated	Absent	Absent	Normal	Normal
4 (SLD)	Normal	Yes	Normal	Elevated	Elevated	Weak or Normal	Weak or Normal	Normal	Weak
5 (GA)	Normal	No	Elevated	—	—	Absent	Absent	Elevated	Normal

\* Ambient is equal to atmospheric pressure.

† May be related to low resting pressure.

We prefer to treat acute injuries of the esophagus with steroids and antibiotic agents as advocated by others.<sup>1, 10</sup> When severe injury is present, early dilatations may be beneficial as regards subsequent stricture formation. This can be accomplished without discomfort with Hurst mercury weighted bougies when burns within the oral mucosa begin to subside. This is usually about the third of fourth day. With encouragement and training, the patient can maintain a patent esophageal tube with frequent self dilatations, without excessive trauma.

While caustic injury can lead to severe esophageal motility disturbances as recorded in this study, it is apparent that the disability which accompanies lye ingestion stems from the fibrotic reparative process which follows. Manometric changes which occurred prior to the appearance of frank stricture is of interest, since it provides a motility pattern in some respects similar to that seen in achalasia. Whether, in fact, these disturbances are a consequence of early disruption of the myenteric plexus is speculative. Further sequential manometric studies of patients who have ingested lye may provide a useful clinical approach towards an understanding of disordered esophageal motility.

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