Benign Esophageal Stricture and The Lower Esophagus Lined by Columnar Epithelium*

Report of Two Cases

SAM W. LAW, M.D.** and ELLA E. SHEEHAN, M.D.†

Houston, Texas

The occurrence of gastric mucosa in the lower esophagus, rather than the usual lining of stratified squamous epithelium, was described by Barrett in 1950. In subsequent discussions, the significance of this rare entity and the complications which may result from it have become clouded by constantly changing terminology and various theories of genesis.1,4

Attempts to evaluate the information presently available about the lower esophagus lined by columnar epithelium rapidly disclose the inadequacies of our knowledge of the normal esophagus. The esophago-gastric junction may be described as the point externally where the tubular esophagus, without a serous coat, flares into the gastric pouch, which is covered by peritoneum. Intraluminally, this point is the junction of the squamous epithelial lining of the esophagus with the columnar cells of the gastric mucosa. Allison utilized the esophagogcscopic placement of metal clips at the squamo-columnar junction to demonstrate radiographically that these two points do not maintain a fixed relationship to each other. It is likely that the concepts of the esophago-gastric junction held by the surgeon, the endoscopist, the radiologist, and the pathologist may differ, despite the use of similar terminology by all.

Derangements of the esophago-gastric junction may be evident anatomically or roentgenographically, or may be functional changes in the poorly understood valve mechanism of the cardia. The concept of peptic digestion of the lower esophagus has been accepted for many years. Reflux esophagitis describes this mechanism and the resulting inflammation of the squamous epithelial lining adjacent to the stomach. Although this may appear in association with peptic ulcer disease of the duodenum, without anatomic derangement of the esophago-gastric junction, it is most frequently seen with an esophageal hiatal hernia. Reflux esophagitis associated with hiatal hernia has many similarities to certain manifestations of the lower esophagus lined by columnar epithelium.

The initial publication by Barrett in 1950, described the occurrence of gastric mucosa lining the esophagus to a level high in the mediastinum. In each patient, deep ulceration had occurred in the columnar cell lined segment of esophagus, resulting in perforation or massive hemorrhage. These have since been called Barrett's ulcers. At that time, Barrett considered this an acquired abnormality, with a tubular portion of stomach drawn upward into the mediastinum by a shortened esophagus.

In 1951, Boshier and Taylor described a 63-year-old woman in whom the lower half of the esophagus was completely lined with gastric mucosa. At the level of the aortic arch, ulceration and stricture formation had occurred at the junction of the gastric and squamous epithelium. A small hiatal hernia was demonstrated roentgenographically, but at operation, the entire stomach lay below the diaphragm. Further documentation of the esophagus lined with gastric mucosa was recorded by Allison and Johnstone in 1953, with the report of seven patients, all elderly, in whom the abnormal distal esophagus was associated with a stric-
ture proximally in the portion lined by stratified squamous epithelium. Each patient also had a sliding esophageal hiatus hernia.

More recently, Barrett\(^4\) has proposed the term “lower esophagus lined by columnar epithelium,” and is uncertain of its genesis. It is entirely possible that the lower esophagus lined by columnar epithelium is a congenital anomaly which remains unrecognized until one of the two known complications appear. Ulceration in this abnormal mucosa, or Barrett’s ulcer, has the characteristics and symptomatology of gastric ulceration, with the potential of massive hemorrhage or perforation. This type of ulcer is usually longitudinal, and infrequently results in dysphagia or stricture. In contrast, the ulceration which occurs in the squamous epithelium above the abnormal mucosa is circumferential, superficial, rarely bleeds massively, and has the characteristics and symptomatology of reflux esophagitis. The patient with this type of ulceration frequently presents clinically with dysphagia.

This report describes two patients with benign stricture of the esophagus lined by columnar epithelium, and without concomitant hiatal hernia.

**CASE REPORTS**

**CASE 1**

This 44-year-old white man was admitted to the Veterans Administration Hospital, Houston, on January 13, 1960, with the complaint of pain on swallowing of increasing severity for one and one-half years. The pain was described as intense retrosternal spasms upon swallowing solids, and occasionally with liquids. Emotional stress intensified these symptoms, and occasionally resulted in the regurgitation of food which could not be swallowed. For brief periods, occasionally up to a month in length, he would be free of significant symptoms. He had progressively restricted his diet to liquids and soft foods.

A diagnosis of duodenal ulcer had been made 25 years earlier on clinical grounds only, but for the many intervening years, he had experienced no symptoms other than occasional mild peri-umbilical discomfort. The remaining history and review of systems yielded nothing of note.

He was a small, thin white man. The vital signs were normal. His abdomen was flat and soft, with a well-healed appendectomy scar. The remainder of the examination was normal.

The hemogram and urinalysis were normal, and the serologic test for syphilis was non-reactive. A quinine carbacrylic resin tubeless gastric analysis (Diagnex) demonstrated no achlorhydria.

The roentgenogram of the chest was normal. Barium contrast examination of the esophagus demonstrated an obstruction at the level of the tracheal carina (Fig. 1). The mucosal pattern and function of the stomach and duodenum were normal.

Esophagoscopy, performed under general anesthesia on February 2, 1960, demonstrated a granular stricture at 34 cm. beyond the incisor teeth. A 16 F. bougie could be passed through the stricture. A biopsy from the proximal margin of the stricture revealed, on frozen section, esophageal mucosa covered with stratified squamous epithelium and an acute inflammatory reaction. The biopsy forceps were then passed through the stricture for approximately 1 cm. and blind biopsies taken. Histologic examination was interpreted as gastric mucosa with acute inflammatory reaction. Bronchoscopy demonstrated a normal tracheo-bronchial tree.

The clinical diagnosis prior to esophagoscopy was carcinoma of the esophagus, and it had been planned to proceed with esophageal resection and esophagogastrostomy. However, with the diagnosis of benign esophageal ulcer and stricture due to the lower esophagus lined by columnar epithelium, this plan was abandoned.

Six days later, after preparation of the colon, he was returned to the operating room in anticipation of esophagogastrectomy with a jejunal or colonic interposition. The esophagus was mobilized through a right anterolateral fourth intercostal space incision and the narrowed and thickened segment was identified just distal to the level of the tracheal carina. The esophagus proximal to this was normal on palpation. Distally, the esophagus was thickened and irregular with the impression of heavy mucosal folds, but there was no visible alteration or abnormality of the muscular coat.

The abdomen was then explored through an upper midline incision. The stomach was normal in character and position with a readily identified infradiaphragmatic esophago-gastric junction, and the esophageal hiatus admitted only one fingertip. The jejunal arcades were short, precluding a jejunal interposition. The distal esophagus was resected and the proximal stomach closed. The right colon was mobilized on a pedicle of the middle colic vessels and passed behind the stomach into the mediastinum through the esophageal hiatus. The cecum was sacrificed, and an esophagocolostomy was created between the mid-ascending colon and the esophagus 1 cm. prox-
imal to the stricture. The distal end of the colon transplant was then anastomosed to the anterior aspect of the proximal stomach. An ileo-transverse colostomy, a Heinke-Mikulicz pyloroplasty, and a decompressive Stamm gastrostomy completed the procedure.

The postoperative course was uneventful, and feedings were started by gastrostomy tube on the sixth postoperative day. On the 12th postoperative day, oral feedings were begun. He refused, however, to take solid foods, and by the 30th postoperative day, stricture of the esophagocolostomy was evident. This readily responded to dilatations to 50 F., and he was again encouraged to widen his diet with only moderate success. Watery diarrhea with abdominal cramps, but without substernal sensation, appeared soon after initiation of oral alimentation. This continued to be a problem for several months, but gradually lessened on full atropinization.

He has returned to work, gained weight, and is able to swallow without difficulty. He has been followed regularly since surgery. A barium contrast study obtained ten months postoperatively demonstrated some narrowing of the esophagocolonic anastomosis, but no further dilatations have been necessary. The interposed colon and the stomach demonstrate normal appearance and function (Fig. 2).

Pathologic Examination: The specimen consisted of a portion of esophagus and proximal stomach, 8.5 cm. in length and 3 cm. in circumference. The proximal 0.5 cm. of the esophagus was covered by a smooth white mucosa. Immediately inferior was an area of ulceration 1 cm. long involving the entire circumference of the esophagus. In this area, the wall was thick and firm with the inner circumference reduced to 2 cm. The distal 7 cm. was light pink, velvety, and in folds resembling rugae. There was no demarcation between the mucosa covering the lower esophagus and that of the stomach.

Microscopic Examination: The distal 7 cm. of the esophagus and proximal stomach was lined by tall columnar cells forming tubular glands. In the proximal portion of this segment the glands were straight, shallow and widely spaced, and lined by cuboidal or columnar cells having pale stained cytoplasm resembling submucosal esophageal glands. In this area were scattered a few minute patches of stratified squamous epithelium. Distally, the mucosa became broader and the glands resembled those of gastric mucosa. With alcian blue-periodic acid Schiff stain, the columnar cells of the submucosal esophageal glands are stained blue, while gastric mucosal cells are bright pink. The possible origin of the abnormal columnar cell esophageal mucosa from the submucosal esophageal glands is unlikely since the staining reaction of the columnar cells

![Fig. 1](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21421/)

**Fig. 1**: Barium contrast esophagogram (Case 1), demonstrating the level of the stricture and the degree of obstruction in the mid-thoracic esophagus. There was no hiatal hernia.

**Fig. 2**: Postoperative barium contrast study (Case 1), demonstrating the function and appearance of the interposed right colon replacing the resected esophagus.
in this entire segment was characteristic of gastric mucosa. Throughout the columnar cell lined segment were numerous parietal cells. No demarcation was evident between the esophagus and stomach.

The proximal 0.5 cm. of esophagus was lined by a slightly broadened stratified squamous epithelium. Distal to this was an area of ulceration with a fibrinopurulent exudate over a vascular granulation tissue. Just distal to the area of ulceration was a narrow rim of stratified squamous epithelium with an abrupt change to the columnar cell mucosa (Fig. 3).

In the area of ulceration the submucosa was replaced by a dense hyalinized connective tissue that in areas extends into the inner portion of the circular muscle layer. At the level of the ulcer and stricture, the circular muscle layer was hypertrophied. The hypertrophy gradually tapered distally for 3 cm. from the ulceration and did not extend to the presumed level of the esophagogastric junction. The longitudinal muscle layer was broadened to a lesser extent in the area of stricture with the hypertrophy tapering distally for 1 cm. Between the muscle layers at the area of ulceration and stricture were numerous enlarged and closely spaced nerves and large groups of ganglion cells. More distally, the submucosa and the muscle layers had the appearance normally seen in the esophagus.

In this junction of the stratified squamous and the columnar cell epithelium is in the middle third of the esophagus at the inferior margin of the ulceration and stricture. This conclusively demonstrates that the ulceration and consequent stricture is entirely within the stratified squamous epithelium of the esophagus immediately proximal to the columnar cell lined segment (20x).

CASE 2

This 71-year-old white man was admitted to the Veterans Administration Hospital, Houston, on March 24, 1962, with the complaint of occasional difficulty with food sticking in the lower retrosternal area during the past year. This had caused little concern until three weeks before admission. In 1947, a brief similar episode had occurred, but there had been no difficulty in the interim. There was no other history of significance.

On physical examination, he appeared to be of the stated age and in fair nutritional condition. There was marked kyphosis of the thoracic spine with distant breath sounds and crepitant rales in both lung bases. The remainder of the examination was not remarkable.

The laboratory examinations were within normal limits. A barium esophagogram demonstrated marked narrowing and irregularity in the middle third of the esophagus, with several outpouchings of the contrast media suggesting diverticula (Fig. 4). The stomach and duodenum appeared normal.

Esophagoscopy demonstrated marked constriction between 33 and 38 cm. from the incisor teeth that was fiery red, ulcerated and irregular. Below this, the esophagoscope passed through apparently normal mucosa until the stomach was entered at 47 cm. Several biopsies taken from the ulcerated area were reported as esophago-gastric mucosa with ulceration. Bronchoscopy revealed a normal tracheobronchial tree.

On April 6, 1962, at exploration through a right anterolateral thoracotomy, the esophagus was narrowed and fibrotic for a distance of 5 cm. beginning just distal to the level of the tracheal carina. Distal to this area the esophagus appeared normal, but on palpation was thicker than usual.

Although an esophageal resection with jejunal or colonic interposition had been planned, the patient tolerated the exploration poorly, necessitating termination of the procedure. Eight weeks later, exploration was again attempted, but induction of anesthesia resulted in marked cardiac irregularities and vasomotor instability. No incision was made, and two days later he was discharged.

When examined three weeks later, he denied difficulty in swallowing, but his diet was markedly limited. He had lost two pounds since discharge.

On September 12, 1962, he was readmitted because of increasing dysphagia for the past three weeks. Esophageal dilatation was easily accomplished on the succeeding two days to a 40 F. size. Repeat esophagoscopy was planned, but he developed acute pharyngitis which was treated.

**Necropsy:** Pertinent findings were limited to the heart and proximal gastrointestinal tract. In the heart there were old and recent myocardial infarcts. The stomach was beneath the diaphragm with the peritoneal reflections as usual and the esophageal hiatus admitting only the tips of two fingers. The external surface of the esophagus was narrowed in its middle-third and elsewhere appeared normal.

On opening the stomach along the greater curvature and the esophagus along its left border to above the pharyngo-esophageal junction, the proximal esophageal mucosa was normal and ended in a circumferential area of ulceration 5 cm. long. In this area the internal circumference was reduced to 1.5 cm. Just proximal to the ulceration the mucosa was puckered, with shallow elevations and depressions covered by intact mucosa. Distal to the ulceration, the mucosa was velvety, blue-pink, and in broad folds resembling rugae. There was no discernible transition between the distal esophageal mucosa and that of the stomach. The stomach and duodenum appeared normal.

**Microscopic Examination:** The distal third of the esophagus was lined by tall columnar cells that formed glands. Proximally, the glands were shallow, straight, tubular, and widely spaced. Although the columnar cells resembled those of submucosal esophageal glands, the alcian blue-periodic acid Schiff staining reaction was characteristic of gastric mucosa. Distally, the mucosa became broader with closely spaced glands. There was no transition between this mucosa and that lining the stomach. Throughout this columnar cell lining of the esophagus were many parietal cells. Fig. 5.

The proximal two-thirds of the esophagus was lined by stratified squamous epithelium with focal areas of hyperplasia. In the distal part of this segment was a circumferential area of ulceration with complete loss of covering epithelium. A narrow rim of stratified squamous epithelium remained distal to the area of ulceration and abruptly continued into the columnar cell mucosa.

In the area beneath the ulceration, the submucosa was replaced by a dense hyalinized connective tissue that in areas extended through the entire wall. Fig. 6. Chronic inflammatory cells infiltrated this hyalinized connective tissue. There were enlarged nerves and large groups of ganglion cells in this fibrous connective tissue and between the remaining muscle layers.

The arrangement and appearance of the circular and longitudinal muscle layers of the esophageal wall was similar to that normally seen in the esophagus. In the proximal portion, the muscle layers were of usual width. In the midportion of the esophagus the muscle layers gradually became broader as they approached the area of stricture. This hypertrophy was more marked in the circular coat. At the proximal margin of the stricture and extending into the area of narrowing, the circular muscle layer be-

**Figure 4:** Barium contrast esophagogram (Case 2), demonstrating the level of the stricture, the degree of obstruction, and the irregularity of this segment. There was no hiatal hernia.
came markedly hypertrophied and then many of the muscle fibers blended into the dense scar tissue. More distally the hypertrophied circular muscle layer gradually tapered to its usual width. The longitudinal muscle coat was similarly hypertrophied, though to a lesser degree. The inflammatory change, hyalinized fibrous tissue, and muscular hypertrophy did not extend to the presumed esophago-gastric junction. In the distal portion the submucosa and muscle layers had the appearance normally seen in the esophagus, with the only alteration being the abnormal mucosa (Fig. 7).

**Discussion**

The rare esophageal abnormality encountered in these two patients has received little attention. Its occurrence, or at least the frequency of recognition, is apparently greater in England than in this country. The total number of patients recorded remains small, and varied interpretations have been given to the observations made on these.

The genesis of this abnormality remains uncertain. Several divergent concepts have been expressed since the original description by Barrett as an acquired anomaly with a tubular portion of stomach drawn into the mediastinum by a cicatrizating and shortening esophagus. Some support for this original view is given in the recent report of Goldman and Beckman. The association of hiatal hernia with this condition in the reports of Bosher and Taylor, and of Allison and Johnstone lends support to the concept of an acquired anomaly. It has been suggested that the development of an esophageal hiatal hernia results in reflux esophagitis with ascending sequential shedding of the stratified squamous epithelium, with progressive extension upward of the gastric mucosa to cover the denuded esophagus. Van de Kerckhof and Gahagan circumferentially stripped the terminal 2 cm. of stratified squamous mucosa of the dog's esophagus. Subsequent observations demonstrated that squamous epithelium rapidly regenerated to cover this defect. It was also noted that the submucosal esophageal glands did not regenerate in this area. In none of the animals was there gross or histologic evidence of extension upward of the columnar epithelium of the stomach.

Hayward views this columnar cell esophageal lining as a temporary upward extension of the "junctional epithelium," which he considers an "esophageal epithe-

**FIGURE 5:** The mucosa lining the lower esophagus closely resembles that normally seen in the stomach. Scattered throughout this segment are many parietal cells (100x).
However, this fails to account for the ulceration which has been observed, both in this epithelium and proximal to it. The entity has also been described as heterotopic gastric mucosa, although it is well documented that ectopic gastric mucosa occurs most frequently as small islets with the greatest frequency in the proximal esophagus.

The marked predominance of the older age group in the patients thus far reported has been the strongest argument against a congenital anomaly. However, in several of the patients described, including those reported here, there were no other anatomic or pathologic changes. The external appearance of the esophagus and stomach was normal, the mediastinum was unaltered, the segmental arterial supply of the esophagus was normal, and the diaphragmatic crura and peritoneal reflections were normal.

The concept of a congenital origin of the lower esophagus lined by columnar epithelium has been given strong support by the recognition of this condition in three young patients. Wyndham, in 1956, described a nine-year-old boy with dysphagia beginning at birth. There was no hiatal hernia, and the lower segment of esophagus lined with columnar cells resembling gastric mucosa contained numerous parietal cells. Groves and Turnbull have recorded the occurrence of this condition in a five and one-half-year-old boy whose symptoms began at the age of two years. Lomasney and Pierce have recently treated a six-year-old girl with dysphagia beginning in infancy, who had a mid-thoracic stricture above a columnar cell lined distal esophagus which contained parietal cells.

The embryonic development of the esophageal epithelium of man has been described by Johns. In the 40 mm. embryo, the esophagus is lined by ciliated stratified columnar epithelium. In the 130 mm. embryo, replacement of this epithelium begins with the appearance of stratified squamous epithelium in the middle third of the esophagus, with simultaneous progression proximally and distally. Patches of ciliated columnar epithelium may still be found in the

**Figure 6:** The bed of the ulceration within the stratified squamous epithelium of the esophagus is composed of dense hyalinized connective tissue diffusely infiltrated with chronic inflammatory cells. In areas this hyalinized connective tissue extends through the entire wall, disrupting the muscle coats (25x). The submucosa and muscle layers are like that normally seen in the esophagus without evidence of inflammation or scarring (30x).

**Figure 7:** The mucosa of the columnar cell lined lower esophagus resembles gastric mucosa. The submucosa and muscle layers are like that normally seen in the esophagus without evidence of inflammation or scarring (30x).
proximal esophagus at birth. Thus, a completely satisfactory explanation of the congenital origin of the lower esophagus lined by columnar epithelium is available, if it can be assumed that the distal progression of the stratified squamous epithelium is halted following its initial appearance in the middle third of the esophagus.

The presence of parietal cells in the columnar cell lining of the lower esophagus of both patients in this report, and in the patients of Wyndham,19 and Lomasney and Pierce19 is evidence that acid-peptic activity, analogous to that seen in reflux esophagitis, is responsible for the ulceration and consequent stricture in the squamous epithelium immediately proximal to the abnormal segment. In other patients4,8,10 it has apparently not been possible to identify parietal cells in the columnar cell lined segment.

From this evidence, there can be no doubt that the lower esophagus lined by columnar epithelium is a congenital anomaly. The incidental necropsy finding of an asymptomatic lower esophagus lined with columnar epithelium has been recently recorded.19 It apparently may remain unrecognized for many years, until one of the two known complications appear. Deep ulceration in the abnormal mucosa (Barrett's ulcer) may produce pain, or proceed to hemorrhage or perforation. Acid-peptic digestion of the squamous epithelium immediately proximal to the abnormal segment may produce circumferential ulceration progressing to stricture formation. It should also be noted that in a recent review of 405 cases of carcinoma of the esophagus, Miller9 found four patients with columnar cell carcinoma in the lower esophagus lined with columnar epithelium.

Proper management of the patient with the lower esophagus lined by columnar epithelium must rest on accurate diagnosis. Absolute exclusion of the presence of malignancy is mandatory. Subsequent management is dependent upon the complication which has appeared, the severity of the symptoms, and the anticipated life expectancy of the patient. Barrett's ulcer, in the columnar cell lined segment, fortunately responds to medical management.14,41 This ulcer may, however, result in severe hemorrhage or perforation, necessitating resection.

Benign esophageal stricture resulting from circumferential ulceration in the squamous epithelium bordering the columnar cell lined segment may be managed with esophageal dilatations.1 However, in the young patient, or in the patient with severe dysphagia, resection of the stricture and the abnormal distal segment will probably be required.14,41 Reconstruction by a mid-thoracic esophagogastrectomy will often be followed by a recurrence of ulceration and stricture in the adjacent esophagus.11 Thus, in this benign process, interposition of a segment of jejunum or colon is distinctly superior.12,18

References
RESPIRATORY FACTOR IN ANGIOGRAPHIC MEDIA TOXICITY

A respiratory reflex has been demonstrated in dogs in association with large intravenous doses of several currently popular angiographic contrast media. This reflex consists of a variable period of apnea, followed by a rapid, shallow tachypnea, and frequently pulmonary edema and hemorrhage. Also associated are a marked increase in pulmonary artery pressure, a fall in systemic pressure, bradycardia, and the rapid development of electrocardiographic abnormalities of rate, rhythm and conduction.

The respiratory reflex is eliminated by bilateral vagotomy, and markedly diminished or entirely prevented by premedication with low molecular weight dextran. Proximal blockade of the pulmonary hilum bilaterally completely eliminated the post-injection apnea. A reflex pathway initiated by multiple emboli of red blood cell clumps, with sense organs in the pulmonary parenchyma, an afferent vagal limb, and an efferent phrenic nerve limb, is postulated.


ETHYL ALCOHOL AND THE CARDIOVASCULAR SYSTEM

Alcohol has the overall deleterious effects of increasing the cardiac work-load and compromising coronary flow. Although the results noted in the animal for experimental use cannot be transferred unreservedly to man, unless and until the human response is demonstrated to be the reverse of that noted above, alcohol should be deemed to have no place in clinical practice as a coronary dilator in angina or as a cardiovascular stimulant. Though the value of its psychic effects in small dosages may justify clinical usage, this effect appears to be related to changing the patient's threshold to pain, rather than having a salutary influence on the pathophysiological basis of anginal pain.


POSTPERICARDIOTOMY SYNDROME

A group of 265 survivors of pericardiotomy over a six-year period at the New York Hospital was reviewed. Of these patients, 80 (30.5 per cent) had the postpericardiotomy syndrome. The monthly distribution of the syndrome formed a pattern that was delineated by a probit method of analysis. February through July was identified as the consecutive six-month period associated with increased incidence of the syndrome. Data associated with the epidemiologic pattern were insufficient to elucidate further etiology of the postpericardiotomy syndrome. The type of surgery performed other than pericardiotomy did not influence the incidence significantly. In this series, there was a decreased incidence of the postpericardiotomy syndrome in patients over 30 years of age.