Epiphrenic Diverticulum of the Esophagus
A Review of Its Surgical Treatment and Report of a Case*

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Articles embracing the incidence, etiology, differential diagnosis, symptoms and complications of epiphrenic diverticulum of the esophagus have appeared not too infrequently in the past.5,9,11,17,18,21,27,30,31 However, except for the notable contributions of Janes,13 Adams,1 and Harrington,10 the surgical aspects of this disease have received scant attention. No article has appeared which considers earlier experiences and thoughts on the surgery of such lesions since the contributions of Lotheissen16-18,31 more than two decades ago. For these reasons, it is felt worthwhile to review in some detail the surgery of such diverticula from the historical standpoint as well as present trends in treatment.

The first proposal for the surgical extirpation of such lesions appeared in 1901, when Enderlen6 suggested that they be removed through a posterior mediastinotomy, an operation conceived by Nassloff in 1888 and first performed a decade later by Rehn.22 On the basis of the few clinical and autopsy cases of such diverticula then known, Enderlen concluded that surgical intervention was rarely indicated and could then be only infrequently attempted, since he considered the following theoretical criteria prerequisites to surgery: 1) The diverticulum must not lie below the level of the ninth thoracic vertebra. 2) It must be free from adhesions with surrounding structures. 3) The pedicle must not be too large. 4) Carcinoma must not be a complication. 5) Excessive malnutrition must not be present. An alternative procedure suggested by Lotheissen16 in 1908, proposed anastomosing the fundus of the diverticulum to the cardia of the stomach (marsi-pogastrostomia) through an abdominal approach and incising the diaphragm to gain access to the diverticulum. He also considered the use of the Murphy button in lieu of suture, recognizing the difficulty of esophageal suture. Since diverticula at a higher level would not be accessible by such an approach, he briefly suggested the possibility of transpleural resection.

Although Deesecker5 credits Enderlen as the first to operate for
an epiphrenic diverticulum, the case of Roux, operated on in 1906, probably deserves priority, although it was not strictly epiphrenic in nature. This lesion was approached by laparotomy and found on the subphrenic portion of the esophagus. Being small, it was incised, obliterated by stretching, and the ensuing defect complicated with uneventful recovery and cure. Enderlen's case reported in 1910 was in a severely emaciated man of 62 years who had preliminary gastrostomy three weeks prior to excision of the diverticulum. Exposure was obtained by a paravertebral extrapleural resection of the third through the seventh ribs on the left side as previously proposed by him. The sac was excised and the defect sutured. Death occurred 26 hours postoperatively of heart failure and autopsy revealed the suture line to be intact. As subsequently commented upon by Lotheissen, this again was probably not an epiphrenic diverticulum because of its high location. That a cervical approach would have been possible as assumed by Lotheissen is doubtful, since he erroneously states that the first through the fourth ribs were resected. It probably represented a rare, large, and symptomatic epibronchial diverticulum of the traction-pulsion variety.

In 1916 Steinlin reported the transthoracic excision of an epiphrenic diverticulum which ended fatally because of fistulization of the suture line and mediastinitis. Clairmont in 1924 reported the case of a 43-year old woman suspected of having carcinoma of the distal esophagus. Subsequent to jejunostomy the esophagus was freed for a distance of 10 centimeters above the cardia and the esophagus pulled down into the abdomen. An epiphrenic diverticulum was discovered, excised, the defect closed with one layer of sutures, and the esophagus allowed to return into the mediastinum. Healing occurred without incident. Sauerbruch had seven cases with severe symptoms unrelieved by a conservative regimen that warranted operation. In two instances an anastomosis was made between the cardia of the stomach and the diverticulum as initially proposed by Lotheissen. The first case terminated fatally from mediastinitis, while the second case, done by Henschen in Sauerbruch's Clinic, was successful. A third case was complicated by dense adhesions between the cardia of the stomach, diaphragm, and diverticulum. For this reason anastomosis was not felt necessary, and a gastrostomy was performed and the diverticulum entered by cutting down upon a previously placed esophageal sound. This patient recovered and was apparently cured.

Although no direct reference is to be found, Lotheissen in 1926 reported that Willy Meyer successfully excised such a diverticulum transthoracically. Sauerbruch in 1927 reported another case suc-
cessfully excised by transpleural excision using his differential pressure chamber. In this case the neck of the sac was transected between clamps and closure accomplished by three layers of invaginating sutures. A pedicle from the previously paralyzed diaphragm was employed to reinforce the suture line. Convalescence was uneventful and symptoms disappeared. An additional excision by the posterior extrapleural route was reported by Quartero\textsuperscript{20} in 1931. The right 10th and 11th ribs were resected, the pouch excised, and closure obtained with a double row of sutures. On the eighth postoperative day a fistula appeared, but the patient went on to recovery with subsequent spontaneous closure of the fistula.

In 1933 Barrett\textsuperscript{2} reported a case successfully excised transthoracically by Romanis through an intercostal incision. The neck of the sac was clamped and transected with a diathermy knife and closure effected with a double row of catgut sutures, a pleural flap being employed to cover the suture line. Postoperative convalescence was uneventful. This case was correctly reported as an intrathoracic esophageal diverticulum, and not one of the epiphrenic variety, a category given to it by subsequent authors, since it is to be noted that the neck of the sac was located at the level of the azygos vein.

Diverticulopexy, first advocated by Schmid\textsuperscript{26} in 1912 and first employed by Hill\textsuperscript{12} in 1917 for pharyngoesophageal diverticula, has also been applied to those of the epiphrenic variety, Lahey\textsuperscript{13} apparently being the first to utilize this method for the latter type. Adams\textsuperscript{3} discusses three cases of diverticulopexy for epiphrenic diverticula done in the prechemotherapeutic era, in old, poor risk patients with excellent results. In none was co-existing cardiospasm present. In the same article Adams reported five other cases treated by primary transpleural excision. The technique employed was to free the pouch, dissect the neck down to the mucosa and to place a straight clamp across the neck 0.5 centimeters distal to the wall of the esophagus. The mucosa was invaginated with a running Cushing stitch and reinforced with a muscle layer of interrupted silk, the mediastinal pleura being closed over it. In this series there were no deaths nor complications. Janes\textsuperscript{13} reported four successful cases of transthoracic diverticulectomy in which the neck was clamped with three straight clamps with transection between the two distal ones, the middle clamp removed and the fringe oversewn with a running catgut stitch, the proximal clamp removed, and the first row invaginated by interrupted Lembert sutures. Finally, the incised mediastinal pleura was closed behind the esophagus, feeling that mediastinitis is thus less likely and that the pleural cavity is better able to
withstand infection should it occur. Harrington, on the other hand, feels that the median fold of the mediastinal pleura should be sewn over the esophageal suture line, but that the posterior fold be left open for drainage. He stresses the importance of separating only sufficient mediastinal pleura necessary to expose the sac, minimal separation of the esophagus from its bed, and the necessity of complete separation of the herniated mucosa from muscle wall. Excision is carried out 1.5 centimeters from the opening into the esophagus over a right angle clamp, the mucosa inverted with a Connell suture, and the muscle closed with a double layer of interrupted silk sutures. Of eight cases reported by him, transpleural excision was accomplished in seven, and in the other, invagination of a small sac with plication of the dilated esophageal wall was done. One patient developed an empyema which responded to thoracotomy drainage. One fatality ensued subsequent to pneumonia and a localized mediastinal abscess. It is of interest to note that six of Harrington's cases had an associated esophageal hiatus hernia. In only one was repair required. Vinson noted hiatus hernia associated with intrathoracic esophageal diverticulum only once in 42 cases, and Granet found this complication only once in 31 cases collected from the literature. The high incidence of such herniae in Harrington's series would tend to question the previous concept that the association of these two lesions is uncommon. The only other report of a successfully excised epiphrenic diverticulum found in a review of the literature is that of Kay. Of two cases associated with short esophagus, one failed to respond to conservative therapy and was successfully excised transthoracically.

In attempting to assess the divergent attitudes toward this lesion, little unanimity of opinion can be found concerning many of the problems presented. The etiology must be considered as unknown, for although somewhat less than half of the reported cases have an associated cardiospasm, there is as much evidence to consider the diverticulum secondary to the cardiospasm as in the reverse order. In this respect, the case of Poppe and Berg is of interest. Their patient had severe cardiospasm associated with a large diverticulum. Repeated dilatation and other conservative measures failed to alleviate the symptoms. On the debatable assumption that the symptoms in such instances are on the basis of the cardiospasm, which in turn is secondary to the diverticulum, a diverticulopexy was performed without benefit, and a subsequent anastomosis of the sac to the cardia of the stomach resulted in symptomatic relief. In partial support of their view, they have quoted Dessecker as reporting two cases of epiphrenic diverticulum, both with cardiospasm. Perusal of this article reveals that
Dessecker reported but one case not associated with spasm. Concerning this problem, Raven felt that "the most reasonable supposition is the presence of distal esophageal obstruction with increased pressure, causing herniation of the mucosa in an area where muscle coats have been weakened by local esophagitis." Smith concluded that deep diverticula are of no importance in the etiology of cardiospasm. The failure of diverticulopexy in the case of Poppe and Berg would appear to argue against such a causal relationship, for one would expect this procedure to have been successful if such a relationship held. Finally, in Janes series, one patient had esophageal spasm, and Harrington noted cardiospasm in three of his cases, yet both authors reported favorable results following resection despite the cardiospasm.

Those cases complicated by hiatus hernia or short esophagus also fail to elucidate the development of such diverticula. One is then reduced to a consideration of those instances where the diverticulum exist independently of such lesions, and here no patent explanation of their origin exists. Several theories have been advanced, such as congenital weakness of the muscular layers, or herniation through weak areas surrounding the nutrient vessels. For a more detailed review of such theories the reader is referred to the articles of Lotheissen, Dessecker, and Janes.

In most instances the diagnosis is not difficult. Though mild dyspepsia may be the sole symptom, dysphagia, epigastric or substernal pain, regurgitation, eructation and even vomiting after meals in conjunction with anorexia and weight loss are characteristic. Esophagoscopy and barium studies will substantiate the nature of the lesion. Some confusion may be encountered in interpreting roentgen studies in which a cardiospasm is accompanied by a large sigmoid dilatation of the distal esophagus, and in esophageal carcinoma, which occasionally causes the formation of a pseudo-diverticulum. In this respect, it is of interest to note that four cases of true epiphrenic diverticulum, complicated by carcinoma, have been reported.

The attitudes regarding the significance of epiphrenic diverticula can best be illustrated by the extremes; Heacock maintaining that they are of little clinical importance, their chief interest lying with the anatomists and the roentgenologists, while Dessecker felt that all such diverticula eventually led to a lethal outcome. Asymptomatic lesions are probably best left untreated; however, those in which symptoms exist, therapy should be instituted. If an associated cardiospasm is present, symptomatic relief can be expected in some instances following dilatation. If relief is not obtained, surgical intervention should be undertaken. The existence of a paraesophageal hiatus hernia or a short esoph-
agus may make it difficult to actually evaluate which lesion is producing the symptoms; nevertheless, it would appear from the literature that surgical excision of the diverticulum will result in cure, although reduction of a hernia may also be necessary. Of all the various surgical approaches and methods which have been employed, only two appear to have any great merit. In extremely poor risk patients, who have no associated cardiospasm, transthoracic diverticulopexy would appear to be a relatively safe and satisfactory procedure. In other instances, a direct transthoracic excision of the lesion seems to be the treatment of choice. The earlier, indirect methods are of historical interest only and should be regarded as a phase in the evolution of esophageal surgery. The present-day esophagogastrostomy, as carried out for carcinoma of the distal esophagus, has not been utilized for the surgical treatment of epiphrenic diverticulum. However, in instances associated with intractable cardiospasm, it may well represent the proper procedure. Although Blondi3 was the first to propose this type of esophageal resection specifically for carcinoma in 1895, Gosset8 independently described the same procedure in a classical paper in 1903 and felt that it might also be used for benign lesions such as diverticulum and cardiospasm as well as for carcinoma. Because of the infrequency of the lesion under discussion and the relatively small number which have been treated surgically, the following case is being reported.

Case Report

(New Haven Hospital C9963) G.Z. A 53-year old Italian housewife was admitted on April 16, 1948 because of epigastric pains. Two years previously she experienced her first attack, characterized by the sudden onset of severe sharp pain just below the xiphoid and radiating along the left costal margin. There was no dysphagia, nausea, or vomiting, but pain was intensifies by swallowing, particularly solids. After one week the patient noted marked improvement, although she still had occasional mild epigastric pain of short duration during or after meals. From this time until admission she limited her diet to soft pureed foods and liquids, since solids caused her more distress. Three weeks prior to admission she again had an abrupt onset of persistent severe epigastric pain following a meal. This was initially sharp, but became gnawing in character radiating along the left costal margin and into the mid-back. Solids and to a lesser extent fluids intensified these symptoms. She was placed on antacids, but failed to improve. Some relief was noted when lying on her right side. There was no vomiting, but there was gaseous eructation and regurgitation of sour fluids. During this three week episode the patient lost 12 pounds. There was no history of icterus, acholic, tarry, or bloody stools, hematemesis, or change in bowel habits. Family and past history were not contributory and system review revealed only irregular menses and occasional menorrhagia.

Upon physical examination the vital signs were: temperature 98 degrees F., blood pressure 144/84, respirations 22, pulse 80. The positive
findings were limited to abdominal and pelvic examination where there was moderate tenderness and voluntary splinting upon deep pressure in the epigastrium, cervical erosion, lacerations, and polyps. Laboratory data revealed a blood count of 4.43 million red blood cells with 13.5 grams hemoglobin, 8,600 white blood cells with a normal differential. Mazzini blood test was negative. Urinalysis, N.P.N., proteins, and chlorides, and an EKG were within normal limits. Roentgenologic examination revealed a smooth, rounded, soft tissue mass, measuring about six centimeters in diameter just to the right and adjacent to the lower third of the esophagus and displacing it slightly to the left. Following the ingestion of barium, direct continuity between the lumen of the esophagus and the previously described mass could be noted with a small amount of barium entering the mass, but incompletely filling it (Figure 1). The wall of the esophagus itself did not appear to be involved; it was dilatable, and changed shape readily. There was no evidence of obstruction to the flow of barium down the esophagus, although there was a slight holdup of the barium at the site of the diverticulum. There was no abnormality of the esophagus distal to the diverticulum, and the stomach, duodenum, and small bowel were normal. A small amount of barium was noted in the diverticulum at the end of five hours. Esophagoscopy demonstrated

Figure 1: Barium swallow revealing poor filling of the diverticulum because of foreign body. The outline of the pouch can be seen however.
a normal esophagus up to the level of 40 centimeters from the upper gum margin, at which point the mouth of the diverticulum was noted at 5 o'clock with the esophageal lumen continuing at 11 o'clock. The sac was filled with foreign body material, and an attempt was made to irrigate this out unsuccessfully. As much was removed by biopsy forceps as possible. Pathological examination of this material revealed it to be composed of vegetable fibers and amorphous debris. Because the previous study of the esophagus had revealed poor filling of the diverticulum, the question of carcinoma within it was raised and a repeat study was done, which again showed poor filling and was essentially unchanged from the previous examination. On April 23, 1948 the patient had excision of a cervical polyp, with biopsy of the cervix, and a dilatation and curettage under intravenous pentothal. Pathological report of the tissue removed showed cervical polyp, chronic cervicitis, and local endometrial hyperplasia.

Postoperatively the patient recovered rapidly from this procedure, and three days later under general endotracheal anesthesia, the left chest was entered through the bed of the ninth rib. After division of the pulmonary ligament and retraction of the left lower lobe, the distal esophagus was freed up just above the cardia and a Penrose sheath placed about it for traction, following which it was possible to identify a large-mouthed diverticulum passing from the posterior aspect of the esophagus into the mediastinum between the descending aorta and the pericardium. The proximal esophagus just above the pouch was freed up bluntly and a second Penrose sheath placed about it for traction. By elevating both tractors it was possible to progressively dissect the very adherent sac from the surrounding structures. The sac itself extended through the thickened muscular layer of the esophagus out into the mediastinum as a well defined thick-walled pouch. It was necessary to place considerable traction on the descending aorta in order to get a good visual field. Finally the entire pouch was delivered without opening it and gauze placed beneath it to protect the mediastinum. The neck of the sac was then opened because of the feeling that carcinoma might be present, and a large amount of decaying gauze was extracted from the sac. When it was completely empty, it was seen to be lined with a mucosa continuous with the esophageal mucosa itself. There was no evidence of local tumor. The sac was excised and then the esophageal wall was repaired by placing inverting sutures of interrupted No. A silk to the mucosa followed by interrupted No. A silk sutures to the thickened muscular layer. This was further reinforced with a plaque of gelfoam. The mediastinal defect where the sac originally lay was thoroughly irrigated with saline, a few crystals of sulfanilamide powder dusted into the wound, and the esophagus replaced in its normal position after rotating it in its usual axis. No attempt was made to close the mediastinal pleura in order to permit drainage into the left pleural cavity. The left pleural cavity was irrigated with saline solution, 100,000 units of penicillin introduced, and the chest closed in layers with an interrupted silk technique.

The patient had received whole blood and electrolytes during the procedure and was maintained on intravenous therapy postoperatively for a period of five days being kept on constant gastric suction for this same period. In addition, she received parenteral vitamins, sodium sulfadiazine and penicillin. At the end of five days the gastric tube was removed.
and the patient started on 30 cc. of water every hour which was well tolerated. Fluids by mouth were rapidly advanced, and the patient was on a Sippy III diet at the time of her discharge 12 days postoperatively.

Pathology: The foreign body removed from the diverticulum consisted of two pieces of dark, yellow-brown masses each 1 x 1.5 x 4 centimeters in size and having a granular, laminated structure. On histologic examination, mononuclear, polymorphonuclear and stratified squamous cells were noted lying in a framework of acidophilic vegetable cells and fibers. The diverticulum itself was a roughly hemispherical sac 3 centimeters

![Figure 2](image1.jpg)

**Figure 2:** Photograph of gross specimen revealing wide mouth and thickened wall on the left. Specimen evaginated on the right to demonstrate ulceration.

![Figure 3](image2.jpg)

**Figure 3:** Low power view showing normal mucosa on the right and ulcer on the left. Only a few muscularis mucosa fibers are present, the remaining portion of the wall being composed of fibrous tissue.
in depth with an orifice 3.5 centimeters in diameter having an irregular wall measuring 0.9 centimeters at one margin and about 0.3 centimeters at the other. The sac was lined with a dull-white membrane defective in two places. One defect was at the very depth of the sac measuring 0.4 centimeters in diameter and covered with dark, red, sanguinous material. The other was linear, two centimeters long but widened to a crater 0.6 centimeters in diameter at one end and covered with a fibrinous, dull, yellow material (Figure 2). Microscopically the sac was lined with stratified squamous epithelium save in the ulcerated areas, one of which was shallow with a connective tissue base infiltrated with mononuclear and polymorphonuclear cells and containing a superficial layer of necrotic tissue. The other ulcer showed chronicity being deeper and composed of a thick base of granulation tissue. The wall of the diverticulum consisted of dense connective tissue containing lymphocytes and plasma cells. The only muscle fibers noted were interlacing bundles of smooth muscle immediately under the epithelium and representing muscularis mucosa (Figure 3).

Comment

In this case, the occurrence of an unexplained foreign body and ulcer formation quite likely explains the recent exacerbation in the patient's symptoms and exemplifies two complications of such esophageal diverticula which justify surgical treatment. Ordinarily, it is neither necessary nor expedient to open the sac at operation; however, the possibility of a carcinoma in this instance warranted such a procedure. The pathology in this case was in no way unusual. The absence of the muscular layers is characteristic of such diverticula in contradistinction to the traction type where all layers of the esophageal wall are represented.

SUMMARY

1) A review of the surgical management of epiphrenic diverticulum of the esophagus has been presented. An evaluation of the various surgical procedures would indicate that transthoracic excision is relatively safe, accompanied with good results and probably the method of choice in most instances.

2) A case of epiphrenic esophageal diverticulum complicated by foreign body and ulcer formation is reported. Surgical excision of the lesion was successfully accomplished.

RESUMEN

1) Se presenta una revisión del tratamiento quirúrgico del divertículo epifrénico del esófago. Una evaluación de los diversos procedimientos quirúrgicos indicaría que la extirpación transtorácica es relativamente segura, se acompaña de buenos resultados y es probablemente el método de elección en la mayoría de los casos.

2) Se relata un caso de divertículo epifrénico esofágico complicado con cuerpo extraño y ulceración. La extirpación quirúrgica de la lesión fue llevada a cabo con éxito.
RESUME

1) Les auteurs présentent une revue générale du comportement chirurgical en présence d’un diverticule diaphragmatique de l’œsophage. L’évaluation des différentes techniques chirurgicales tend à montrer que l’intervention trans-thoracique est relativement sûre; les résultats en sont bons, et il est probable que dans la plupart des cas, c’est une méthode de choix.

2) Ils rapportent un cas de diverticule diaphragmatique de l’œsophage compliqué par un corps étranger, avec constitution d’ulcération. L’exérèse de la lésion put être réalisée avec succès.

REFERENCES