DIAPHRAGMATIC HERNIA OF CHILDREN*

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DIAPHRAGMATIC HERNIA occurring in infants and children presents many problems of diagnosis and treatment that differ markedly from those caused by such herniae occurring among adults. One of the principal reasons for this variation is the difference in the types of diaphragmatic hernia which are most commonly encountered in these periods of life.

Although any of the various types of diaphragmatic hernia may be encountered in any period of life, the more common types seen among infants and children, in order of frequency, are those due to embryologic structural defects of the diaphragm, namely, pleuroperitoneal hiatus herniae and those caused by congenital absence of the diaphragm. Next in probable order of frequency are esophageal hiatus and traumatic herniae.

TABLE I

DIAPHRAGMATIC HERNIA

SITE OF OPENING AND CONTENTS OF HERNIA IN 304 ADULTS AND CHILDREN

Site of Opening	Adults	Children	Contents of Hernia	No. of Cases
Esophageal hiatus	222	5	Stomach (omentum)	215
			Stomach, omentum and spleen	4
			Stomach and colon	8
Esophageal hiatus with short esophagus	15	0	Stomach only	15
Hiatus pleuroperitonealis	2	6	Right colon and small bowel	4
			Colon, small bowel, stomach and spleen	4
Absent posterior fourth of left diaphragm	1	6	Stomach, colon, small bowel and spleen	4
			Colon and small bowel	2
			Colon, appendix, small bowel and spleen	1
Foramen of Morgagni (subcostosternal)	5	0	Omentum only (2) and fat (1)	3
			Colon and omentum	1
			Omentum, cecum, appendix, colon and terminal ileum	1
Left hemidiaphragm	37	4	Stomach only	5
			Stomach and colon	10
			Stomach, colon, small bowel (24), spleen (15) and liver (8)	26
Right hemidiaphragm	1	0	Stomach, duodenum, colon, small bowel, liver (gallbladder) and head of pancreas	1
Total	283	21		304

In adult life the most common type of diaphragmatic hernia encountered is that which occurs through the esophageal hiatus. Although this type of hernia may be considered congenital in origin, the actual herniation often does

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not occur until late in life. Other types of diaphragmatic hernia occurring among adults, listed in the probable order of frequency, are traumatic herniae, subcostosternal (foramen of Morgagni) herniae, and those resulting from structural deficiencies of the pleuroperitoneal membrane.

In a series of 304 cases of diaphragmatic hernia in which operation was performed at the Mayo Clinic, 283 of the patients were adults and 21 were children 12 years of age or less. The relative frequency of the occurrence of the various types of hernia among adults and children and the abdominal viscera involved in the hernia in this series are shown in Table I.

The reason for the relative infrequency of those herniae that occur through structural defects of the diaphragm among adults is that most of the infants who are born with this type of hernia die in the first few hours or days of life of cardiac or respiratory difficulty resulting from the marked unilateral alteration in intrathoracic pressure at a time when the compensatory respiratory and cardiac reserve has not been developed to a sufficient degree to maintain function. However, if the respiratory and cardiac mechanisms are able to compensate for the presence of the abdominal viscera in the thorax, the patients may reach childhood or even adult life without any great amount of disability or symptoms, provided that intestinal or gastric obstruction does not develop. When the stomach is involved in these herniae, it usually becomes markedly dilated and the patients often have symptoms of partial gastric obstruction. Intestinal obstruction may occur owing to bands of adhesions between the omentum and loops of bowel, owing to inflammatory conditions of the bowel, or owing to appendicitis.

The clinical recognition of diaphragmatic hernia on the basis of subjective symptoms alone is often difficult. The symptoms are complex because of the various structures involved in the hernia. They depend on the amount of mechanical interference with the function of the herniated abdominal viscera, on the degree of the impairment of the normal function of the diaphragm, and on the amount of increased pressure within the thorax causing impairment of respiration and circulation.

The urgency of establishing a diagnosis is not as great in the case of adults as it is in the case of infants. In the latter case it is extremely important to establish a diagnosis as soon as possible. Many of these infants are born with a rapid, feeble pulse, are cyanotic, and are often considered to have cardiac disease. When infants present symptoms of cardiac or respiratory difficulty the thorax should be examined immediately; if possible, a roentgenogram should be made, and if a hernia is present, treatment should be instituted immediately.

The pleuroperitoneal hiatus types of hernia and herniae due to congenital absence of the diaphragm, which are the most common types of diaphragmatic herniae seen among infants and children, may be considered under one general heading as both of these types of hernia are caused by deficiencies of the development of the pleuroperitoneal membrane, which forms the posterolateral portion of the adult diaphragm.

The former (the pleuroperitoneal hiatus hernia) is due to a lack of fusion of the pleuroperitoneal membrane with the septum transversum, which results in a congenital continuity between the peritoneal and thoracic cavities. The opening is in the posterolateral portion of the diaphragm but varies with the amount of deficiency which has occurred in the formation of the pleuroperitoneal membrane. The opening is usually triangular or elliptic in shape and may be entirely within the diaphragmatic muscle posterolaterally, or there may be no diaphragm posteriorly with a triangular shaped opening reaching to the thoracic wall laterally with its apex toward the central tendon. In this type of hernia the abdominal viscera which usually are involved are the cecum (appendix), ascending colon, greater portion of the transverse colon and practically all of the small intestine. In the larger herniae which present posteriorly, the spleen may be involved. The stomach is usually in the abdomen. It may be markedly dilated and at times extend into the pelvis.

In the second type of congenital hernia, which is due to absence of the posterior portion of the diaphragm, there is a much larger deficiency caused by lack of formation of that portion of the diaphragm derived from the pleuroperitoneal membrane and probably the wolffian body. There are various gradations of the amount of the defect so that the size of the opening varies with the amount of the deficiency of the formation of the diaphragm. It usually amounts to approximately a fourth of the hemidiaphragm posteriorly, from the angle of the ribs laterally to the median portion of the diaphragm close to but not involving the esophageal hiatus. In this type of hernia the same abdominal viscera are involved as in the pleuroperitoneal hiatus types of hernia. The viscera involved are the ascending and transverse colon, small intestine and spleen, and, in addition, usually the stomach and occasionally the left lobe of the liver. The left kidney is usually elevated to a position above the level of the diaphragm in this type of hernia, while in the pleuroperitoneal hiatus type of hernia it is below the level of the diaphragm.

It is difficult to differentiate these two types of hernia clinically because the roentgenologic examination is often misleading in cases in which hernia results from congenital absence of the posterior portion of the diaphragm, as in many instances, at the time of the roentgenologic examination, the stomach is found to be in the abdomen and, at the time of the operation, it is found to be herniated into the left thoracic cavity. This I believe is due to the weight of the barium which causes the stomach to drop into the abdomen where it undoubtedly is a great deal of the time during life. It doubtless goes back and forth through the large opening posteriorly because the opening extends up to the esophageal hiatus. Because of the roentgenologic finding of the stomach in the abdomen, this type of hernia may be thought to be a true pleuroperitoneal hiatus type of hernia rather than due to a congenital absence of a larger portion of the diaphragm.

These herniae rarely have a hernial sac, and the abdominal viscera are in direct contact with the thoracic viscera. There is usually a failure of rotation of the colon and occasionally the small bowel is enveloped in a congenital

peritoneal fold which constitutes an internal hernia. In many instances there is a congenital malformation of the mesentery of both large and small intestines. This is very important surgically and great care must be exercised in replacing the intestines into the abdomen because of the danger of twisting the mesentery upon itself and obstructing the blood supply to the intestine. The herniated viscera produce marked or complete collapse of the left lung and often cause a marked shift of the mediastinum to the right. This shifting of the mediastinum depends on the amount of distention of the herniated abdominal viscera.

As I have stated previously, although the esophageal hiatus type of hernia may be considered to be essentially of congenital origin owing to defective formation of the esophageal hiatus, it usually does not occur until later in life. This type of hernia, however, may be of congenital origin and occur at birth, but the congenital occurrence of this type of hernia is relatively infrequent as compared to those herniae resulting from structural deficiencies of the diaphragm.

There are several types of esophageal hiatus herniae caused by the situation of the muscular defect of the hiatus. The most common site of the defect in the case of children is posterior. This type of hernia may be thought to occur through the aortic opening, but there is usually a small membranous portion of the defective hiatus in front of the aorta and the hernia does not occur through the anatomic aortic opening, which, in reality, is situated back of the diaphragm. The muscular defect of the hiatus in adult life is more commonly situated to the left of the esophagus and permits the stomach to extend into the posterior mediastinum and left side of the thoracic cavity. Occasionally, the muscular defect in the hiatus is situated posteriorly. In this instance, the herniated viscera extend into the right side of the thoracic cavity.

I believe that the occurrence of these esophageal hiatus herniae, both the congenital and acquired types, has a definite relationship to the embryologic formation of the posteromedian portion of the diaphragm as well as to the embryologic relationship of the descent of the stomach and the transverse septum. The transverse septum with the pleuroperitoneal membrane begins to migrate caudally in the 7-Mm. embryo and rapidly passes the pulmonary buds and the anlage of the stomach, placing the greater portion of the lung in the pleural cavity and the anlage of the stomach partially above the diaphragm.

In the 11-Mm. embryo, the stomach, which has been practically stationary, follows rapidly behind the descending septum transversum, and in the 17-Mm. embryo it has virtually reached its permanent position. This descent is made possible by the sudden elongation of the esophagus. During this descent the right and left dorsopleural recesses are converted into bursae which surround the cardia. The left bursa usually disappears, and the right bursa, when well developed, is known as the "infracardiac bursa" and bears a definite relationship to congenital esophageal hernia.

Inasmuch as the stomach descends behind the septum transversum, if

there is a delay in descent of the stomach, the lumbar portion of the diaphragm will be imperfectly developed and the esophageal hiatus will be formed around the cardiac end of the stomach instead of around the esophagus. This will result in an abnormally large hiatus with deficiency both in the muscle ring and in the attachments of the diaphragmatico-esopageal membrane. The degree of the deficiency depends on the amount of gastric anlage in the thorax at the time of muscularization of the lumbar portion of the diaphragm. In rare instances, the stomach may remain in the elevated position as a result of a congenitally short esophagus and a partial thoracic stomach will result. In most instances, the esophagus continues to elongate normally, thus placing the stomach below the diaphragm. This abnormal position of the stomach will cause an abnormal enlargement of the esophageal hiatus with a wide space between the margin of the muscle and the wall of the esophagus. It will also result in imperfect fixation of the diaphragmatico-esophageal elastic tissue membrane to the esophagus and stomach and in an abnormally large peritoneal fold extending well down on the cardia of the stomach. This abnormal relationship will permit much more flexibility of the esophagus in the enlarged hiatus than is normal. The more defective the formation of the hiatus, the more likely is herniation of the stomach to occur through it in later life. The true congenital hernia, present at birth, may be explained in the same way, but it is probable that persistence of the dorsopleural recess may be a factor in the origin of congenital esophageal hiatus hernias.

In the series of 304 cases which I have operated upon, the relative incidence of traumatic hernia was slightly higher among children (19 per cent) than it was among adults (13.4 per cent). Traumatic diaphragmatic hernia may be caused by direct or indirect injury, or by inflammatory necrosis of the diaphragm. In cases of indirect injury of the diaphragm, the hernia may occur at any point, including points of embryologic fusion, but the most common sites are the dome and posterior half of the left part of the diaphragm. However, the injury may occur in the right part of the diaphragm. The laceration most commonly occurs in the posterior third of the left hemidiaphragm; it may be entirely within the suspended portion of the diaphragm, extending to but rarely involving the esophageal hiatus. It may extend to the thoracic wall and the diaphragm may be partially torn from its attachment to the thoracic wall. In case of direct injury of the diaphragm, the hernia may occur at any point and is usually the result of penetrating wounds, such as gunshot and stab wounds.

These traumatic herniae do not have a hernial sac, and the abdominal viscera are in direct contact with the thoracic viscera. The condition in these cases may be more properly termed "evisceration of the abdominal organs into the pleural cavity" rather than a "true hernia." The most common abdominal viscera involved in the hernia are the stomach, colon, small intestine, spleen, and occasionally the liver.

The most marked immediate symptoms usually are respiratory and circulatory embarrassment. The sudden onset of symptoms in cases of traumatic

hernia usually is directly attributable to the injury and there is rarely a question as to the clinical diagnosis. Surgical treatment is demanded because of the danger of cardiac and respiratory failure or because of intestinal strangulation.

SURGICAL TREATMENT

The urgency of and the indications for surgical treatment in the case of infants and children differ from those in the case of adults because of the more frequent occurrence of herniae caused by structural deficiencies of the diaphragm among infants and children. This type of hernia demands immediate surgical intervention because the longer the interval between birth and operation the greater the technical difficulties and the greater may be the hazard of operation. If operation is delayed for a long period, the abdominal viscera will have lost their right of residence in the abdomen, in that the abdominal cavity will not have developed sufficiently to contain them and there will be marked increase in the intra-abdominal pressure when the viscera are placed in the abdomen. At birth, the defect is relatively smaller in proportion to the size of the thorax than it is later in life. In the case of infants who live, the thoracic wall grows away from the posterior margin of the defective diaphragm because there is no posterior attachment. The opening which must be closed, therefore, becomes much larger as the child becomes older. Even though the diaphragmatic muscle is relaxed by interruption of the phrenic nerve, there may not be sufficient diaphragm to span this opening. In cases in which the hernia is due to congenital absence of the posterior portion of the diaphragm, the defect is often proximal to the left kidney and the pararenal fascia can often be utilized in completing and securing the closure after interruption of the phrenic nerve.

One of the chief dangers associated with the repair of these herniae is marked alteration of intrathoracic or intra-abdominal pressure. It is very important in these cases that the respiratory function be maintained by positive pressure during the operation and that at the completion of the operation a negative pressure be obtained and secured in the thoracic cavity. A roentgenogram should be made at the completion of the operation to insure that there is no shifting of the mediastinum owing to the pneumothorax. I do not permit the patient to leave the operating table until I have seen the roentgenogram. If there is any shifting of the mediastinum, more air is withdrawn to maintain the mediastinum in the midline.

I believe it is advisable to effect a temporary interruption of the phrenic nerve preliminary to repair of these herniae, as in some instances it may not be necessary for the resultant paralysis to be permanent. A piece of black silk is looped around the nerve and anchored to the posterior border of the sternomastoid muscle for future localization of the nerve if it is thought necessary to make the paralysis permanent. I do not think it is ever advisable to paralyze the diaphragm of an infant permanently unless it is essential to repair of the hernia, as such paralysis may lead to an eventration of the

diaphragm which may be associated with gastric and intestinal symptoms later in life. A temporary interruption of the phrenic nerve will paralyze the diaphragm for three to six months and, in the case of infants, I prefer to do this immediately preceding the abdominal repair of the hernia which is done under general anesthesia.

I prefer ether as the anesthetic agent for infants and cyclopropane for adults. In all herniae in which there is a direct continuity between the abdominal and pleural cavities I prefer intratracheal administration of the anesthetic agent by means of a positive pressure machine.

In the treatment of all herniae that have occurred through the left portion of the diaphragm, I prefer the abdominal approach by means of an oblique left rectus incision, starting at the ensiform cartilage and extending to the outer border of the rectus muscle. I believe there is less risk of the occurrence of thoracic complications when this approach is used. It is of particular advantage in cases of esophageal hernia as the herniated stomach is usually confined in a sac in the posterior part of the mediastinum and does not enter the true pleural cavity. Inasmuch as these abdominal viscera have herniated into the thorax, their true relationship can be more readily determined by following their course from the abdominal side, and if an injury to the stomach or other abdominal viscera occurs during the operation, it can be readily recognized and immediately repaired.

In the repair of herniae through the right portion of the diaphragm, I prefer the thoracic approach, because the large, right lobe of the liver makes the abnormal opening in the diaphragm inaccessible from the abdominal approach.

The technical difficulties of adequate exposure of the hernial openings through the left portion of the diaphragm and the esophageal hiatus are often considerable because of fixation of the left lobe of the liver to the leaf of the diaphragm. The exposure of these hernial openings is greatly facilitated by cutting the suspensory ligament and retracting the left lobe of the liver to the right. This can be accomplished, when the left lobe is small, by folding it on itself, and when it is large, by retracting it forward into the wound. The spleen is often very adherent to the posterior part of the diaphragm and hernial openings, but usually can be separated from these structures by blunt dissection. In some instances the spleen has been so injured and so firmly fixed in its abnormal position by adhesions that it cannot be separated from the hernial opening without serious injury. This not uncommonly occurs in the traumatic types of hernia and occasionally in esophageal hiatus herniae. In such instances, splenectomy is necessary.

In congenital herniae of infants, it is very important to remove carefully the herniated viscera from the thorax directly into the abdominal cavity and not permit the intestine to be exposed or injured with sponges any more than is absolutely necessary, as this adds a great deal to the shock of the operation. Great care should be exercised in carefully replacing the viscera in the abdomen so as not to produce a volvulus or interference with the blood supply.

After carefully replacing the viscera into the abdomen, the abnormal opening in the diaphragm is closed with interrupted silk sutures. In the case of adults, the tissues are first stabilized by interrupted silk sutures and then fascia lata which has been removed from the thigh, is interwoven between the overlapped layers and along the margin of the closure. The latter method is particularly advantageous in cases of traumatic herniae in which the diaphragm has been torn from the thoracic wall.

In all cases in which there has been a direct communication between the abdominal and the thoracic cavities, every effort should be made to reestablish the negative pressure within the pleural cavity by removing the air and by expanding the lung before the opening in the diaphragm is closed completely. In some instances, this cannot be accomplished until after the rent in the diaphragm has been closed. In some cases pneumothorax may push the mediastinum and heart to the opposite side and cause marked embarrassment of respiration and circulation. In these cases it is imperative that the mediastinum be stabilized in the midline immediately, by aspirating the air from the pleural cavity with a needle until the pressure becomes negative. I think it advisable to make a roentgenogram before the patient leaves the operating table, for the purpose of determining the amount of pulmonary expansion present.

Most patients are given a blood transfusion either during or immediately after the operation. The blood of every patient is grouped for transfusion before the operation. If the systolic blood pressure decreases to 90 Mm.Hg., or less, the patient should receive a transfusion of blood. I believe it is very important to maintain blood pressure at a fairly constant level and not permit it to drop more than 20 Mm.Hg. below the normal preoperative reading. I prefer the use of blood transfusions to the intravenous use of solutions to maintain the blood pressure. Blood transfusions are also advisable in all cases in which the hernia is associated with loss of blood that produces secondary anemia.

If there is excessive mucus in the bronchi and lungs at the time of operation, it is imperative that it be removed by aspiration through the intratracheal tube used for the administration of the anesthetic agent, or by the use of the bronchoscope before the patient leaves the operating table.

On removing the patient to his bed, which has been made warm by hot water bottles, external heat is applied to the patient by use of additional hot water bottles. Fifty-eight to 60 per cent oxygen is administered in an oxygen tent until the patient has fully recovered consciousness, and the administration is continued thereafter as indicated. After the patient has fully regained consciousness, the oxygen may be administered with a nasal mask.

RESULTS

The results of operation in this series of 304 cases of various types of diaphragmatic hernia, in which 283 of the patients were adults and 21 were children, were as follows: There were 15 deaths following operation in the

entire series, or an operative mortality of 4.9 per cent. Eleven deaths occurred among adults and four among children. Of the 11 deaths among adults, nine occurred after operation for esophageal hiatus type of hernia, one after operation for repair of hernia due to congenital absence of the posterior portion of the diaphragm, and the remaining one after operation for traumatic diaphragmatic hernia. The cause of death in these 11 cases was pneumonia and pulmonary edema in five, cardiac disease and coronary sclerosis in three, cerebral embolism in one, pulmonary embolism in one, and mesenteric thrombosis in one.

Of the 21 infants and children operated upon, four died. Three died after operation for pleuroperitoneal hiatus type of hernia, and one after operation for repair of congenital absence of the posterior portion of the diaphragm. These children were 7, 9, 18, and 24 months of age, respectively, and in all instances death occurred within 48 hours after operation. One child died at the time of operation soon after the opening in the diaphragm had been exposed but before the repair of the opening had been begun. The causes of death of the four children were respiratory and cardiac failure, with partial atelectasis of the lung.

There were nine recurrences, all of which occurred among adults who had esophageal hiatus types of hernia. Of these nine patients, five had no recurrence of symptoms and recurrences were diagnosed because of a small protrusion of the cardia of the stomach above the diaphragm. Three of these five patients had a moderate shortening of the esophagus before operation. In this type of hernia it is not uncommon to find a small portion of the cardia above the diaphragm following operation. This may not progress and reoperation is not indicated unless there is recurrence of symptoms. In the case of the remaining four patients there was a definite recurrence of the hernia and subjective symptoms. A second operation was necessary for complete relief of symptoms in three cases and partial relief in the remaining case. There were no recurrences following operation in any of the other types of herniation among adults, and no recurrences following operation in the case of any of the children.

Of the entire series of 304 patients who were operated upon for various types of diaphragmatic hernia, 289 recovered from operation; four of the 289 required a second operation before obtaining relief of symptoms.

DISCUSSION.—DR. ALBERT O. SINGLETON (Galveston, Texas): I was very glad that Doctor Harrington should make his maiden presentation before this organization on diaphragmatic hernia, a subject upon which he is such an outstanding authority. We have been in a quandary relative to the method of repair of some of these difficult herniae. In those about the esophagus in which there is an absence of diaphragm between the esophagus and aorta, a great deal of difficulty has been experienced. In two instances, we have transferred the esophagus further forward in its diaphragmatic penetration and closed the diaphragm behind the esophagus. In two cases of very large hernia in the anterior portion of the diaphragm, we have found it necessary to transplant a large patch of fascia from the thigh, and it has

functioned satisfactorily. We have also experienced a considerable degree of satisfaction in operating upon large diaphragmatic herniae, other than esophageal, through the thoracic approach, finding it much easier than through the abdominal approach. I should be very much pleased if Doctor Harrington would comment upon these points which I have mentioned.

DR. J. D. RIVES (New Orleans, La.): I should like to comment on one of the questions asked by Doctor Singleton. In the case of a very large defect such as he has described, it is quite likely that the best approach would be abdominal, because until exploration has been made it might well be impossible to determine the location and size of the opening in the diaphragm. This would not interfere in any way with the use of the procedure we have proposed for the closure of large defects in the anterior portion of the diaphragm, provided the exploration had been undertaken through a midline or a transrectus incision. I believe that the mobilization of the transversus abdominis would provide a well-vascularized sliding graft that would serve the purpose admirably, and it would be much simpler to do this than it would be to obtain a free graft from some other location.

DR. S. W. HARRINGTON (Rochester, Minn., closing): There is considerable difference of opinion among surgeons concerning the details of the operative technic for diaphragmatic hernia. Limited time did not permit me to discuss many of these technical problems.

Doctor Singleton has asked for discussion of two important technical considerations; namely, the type of approach to be utilized (whether through the thoracic or the abdominal cavity), and the method of closure of esophageal hiatus hernia caused by structural deficiency of the hiatus posteriorly.

I have used both the thoracic and abdominal methods of approach. I prefer the abdominal approach for all herniae through the left hemidiaphragm because when it is used I believe there is less risk of thoracic complications. For herniae through the right hemidiaphragm, I prefer the thoracic approach because the large right lobe of the liver interferes with exposure of the hernial opening. In some types of hernia, such as traumatic hernia and hernia due to congenital structural deficiency of the leaf of the diaphragm, the type of approach may be considered to be the surgeon's choice, because the defect usually is accessible for repair by either method. In the treatment of esophageal hiatus hernia, however, I believe that there are many fundamental advantages in utilization of the abdominal approach, because this type of hernia is sliding and does not enter the pleural cavity; rather, it enters the posterior portion of the mediastinum, behind or lateral to the pericardium.

Removal of the hernial sac or the attachments of the sac to the stomach is one of the important steps in the operative repair of these hernias. The attachments of the hernial sac to the stomach can be exposed only by the abdominal approach. The presence of any associated esophageal lesion, such as traumatic erosion or ulcer, or any injury to the herniated abdominal viscera occurring during the operation, can be recognized readily and treated, if necessary, through this approach.

The type of defective hiatus present can be determined, and hernia due to the posterior structural deficiency of the hiatus can be repaired with less risk of injury to spleen, aorta, and caudal lobe of the liver.

Another important technical consideration in the repair of posterior hiatal hernia, is interruption of the left phrenic nerve for elevation of the diaphragm, so that the opening can be closed around the esophagus at a higher level, since there is usually a moderate shortening or contraction of the esophagus

which elevates the cardia of the stomach. It is also important to imbricate several strands of fascia lata into the closure of the posterior margins of the hiatus. This procedure usually insures a very satisfactory and strong closure of this elevated position of the esophagus above the cardia. I have utilized this method of treatment of true congenital short esophagus of moderate degree, in which the surgical problem is not only repair of an enlarged hiatus but also elevation and reconstruction of the diaphragm above the cardia of the stomach.

As to the question of repair of anterior defects of the diaphragm, I may say that I have operated upon four patients who had presented large structural deficiencies of the muscle, and I obtained very satisfactory results by utilizing the fascia of the rectus muscle and reenforcing this with the round ligament of the liver.