HERNIA

The Pathologic Anatomy of the More Common Hernias and Their Anatomic Repair

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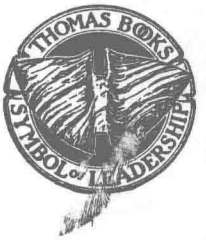

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HERNIA

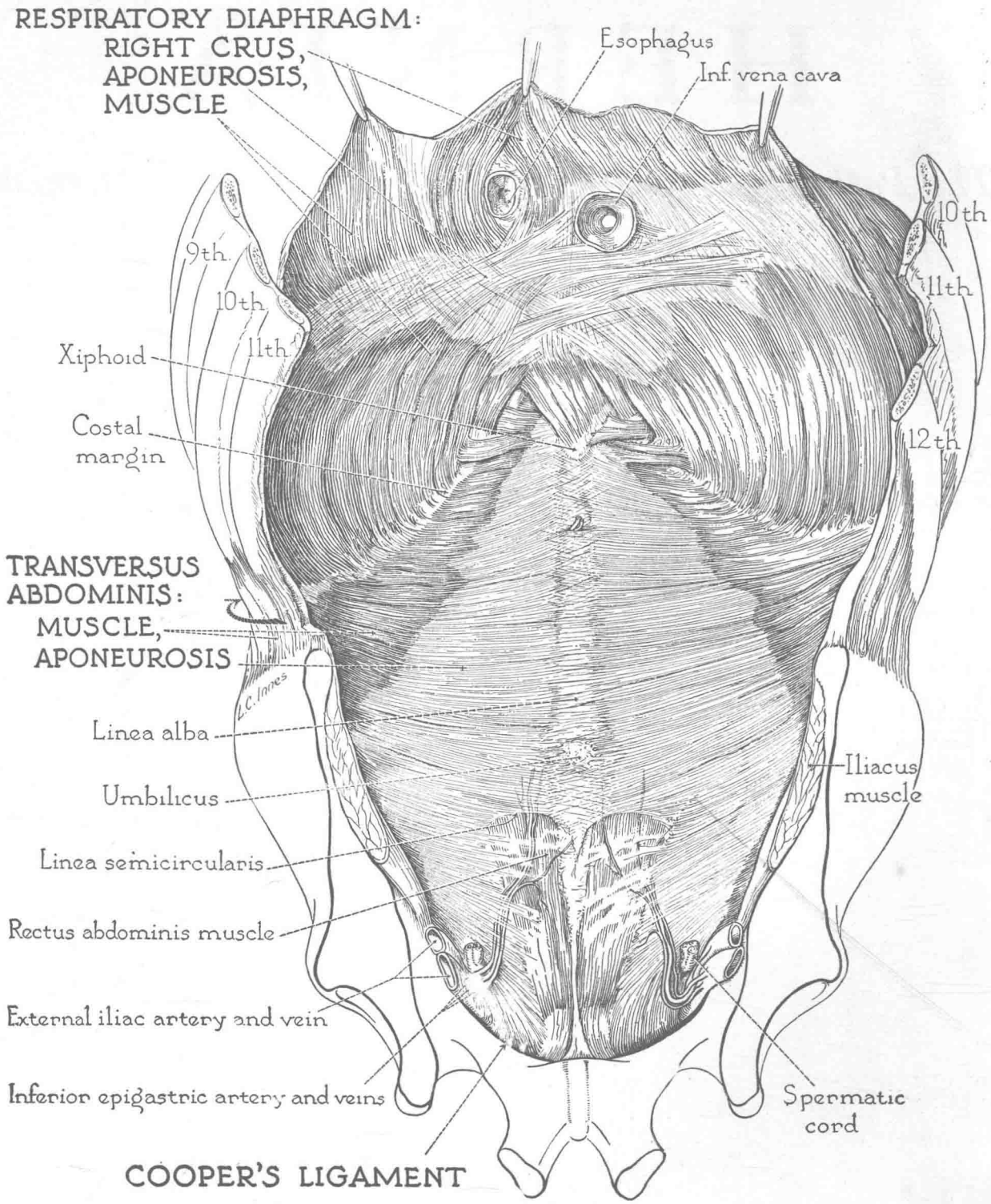

PLATE I. *Frontispiece.* Posterior view of the anterior abdominal wall and the respiratory diaphragm with the peritoneum, preperitoneal connective tissue and the transversalis fascia removed to demonstrate the disposition of the musculoaponeurotic fibers of the transversus abdominis layer and the diaphragm. This layer is the key to the development of all parietal hernias and must have first consideration in any procedure for the surgical correction of a hernia.

A Monograph in the

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Introduction

IT IS NOT INTENDED that this atlas should be comprehensive but rather that the text be brief and tied intimately to the illustrations so that the text for the figures will always be either on the same or the opposite page. There are a number of excellent texts on hernia, some of them encyclopedic in scope, that cover the subject in detail, including variations in type of a given hernia and a host of different surgical techniques. Nowhere in the field of surgery is there such a multiplicity of operations for a given anatomic defect; this not only reflects basic misunderstanding of the problem involved but is most confusing to the young surgeon.

The purpose of this atlas is to present the common types of hernia in simple form, stressing the anatomic defect, either congenital or acquired, and to present the methods preferred by the author for surgically correcting these defects in anatomic structure. The external appearance of hernias of the abdominal wall and the management of the peritoneal sac have not been emphasized except for the appearance of incisional hernias and the management of the sliding type of hernia; likewise, the diagnosis and the differential diagnosis of the various hernias will not be discussed. Occasional pictorial reference will be made to the skin incision, but in general this author believes that all skin incisions should be in the lines of skin cleavage, irrespective of their location. The final closure of the wound is omitted as noncontributory to this atlas and while no specific discussion of suture material will be presented, non-absorbable suture of the smallest caliber commensurate with good surgical repair is the author's preference.

A constant pattern has been adopted for the presentation of each type of hernia. First, an anatomically accurate view is shown of the musculoaponeurotic defect stressing the basic alterations of normal anatomy that permit the hernia to develop; and second, the successive major steps in the surgical correction of this anatomic defect are presented. In every instance the anatomic defect has been prepared from a cadaver dissection of the hernia so that the alteration in the musculoaponeurotic structure will be accurate in every detail. The anatomic plate in each type of hernia is a posterior view of the anterior abdominal wall in the region of herniation and although this will be an unfamiliar approach to the problem for many surgeons, the author hopes to impress upon his readers the importance of the innermost of the musculoaponeurotic layers, the transversus abdominis. The more superificial internal oblique and external oblique layers are only of secondary importance, for once a hernia has penetrated the transversus abdominis layer a hernia exists, and the oblique musculoaponeurotic laminae only serve to modify or direct the course of the developing hernia. Noncontributory structures such as peritoneum, preperitoneal fat and fascia, and in some instances muscular fascia have been removed so that the fundamental musculoaponeurotic defect may be clearly seen.

The surgical repair was first performed upon the cadaver so that anatomic detail would be accurate and then modified where necessary to conform to the surgeon's view at the operating table. It has been the author's teaching experience that not only is it frequently difficult to transpose the anatomy from the dissecting table to the operating table because of a difference in perspective but also that a surgeon who repairs hernias is not *ipso facto* an anatomist. It is a curious incongruity that most of our recent generation of surgeons are only haphazard anatomists; this is due in part to a decreasing emphasis on gross anatomy in our medical schools in the past three decades and in part due to the increasing emphasis on the more dramatic albeit important basic sciences in our graduate training programs. In many branches of surgery this is of no serious consequence but a hernia is an anatomic derangement and to un-

derstand the cause and especially the repair of a hernia, a detailed knowledge of the anatomy of the layers involved is absolutely essential. To attempt the repair of hernias without intimate and detailed knowledge of the anatomy of the region is to invite a formidable recurrence rate. One has only to review the many methods of repairing an inguinal hernia to realize that something is very radically amiss, otherwise there would have been no necessity for such a multiplicity of operations in so small an area.

It is recognized by the author that there are many "accepted" methods of repairing a given hernia and concerning inguinal and femoral hernias the methods are legion; however, in this atlas only one method is presented for each type of hernia and it is obviously the author's preference. To avoid encumbering this simple atlas with multiple references to the literature, bibliographic references, including the author's own contributions, will be omitted.

The excellence of any atlas is dependent upon the quality and accuracy of the illustrations. In this instance I am especially indebted to Mrs. Lucille Cassell Innes whose excellence of illustration is obvious and for her suggestions concerning surgical perspective which should help to clarify the many problems encountered in teaching the surgical repair of hernias. I also wish to express my deep appreciation to two men who have profoundly influenced me as an anatomist and as a surgeon, Barry J. Anson, Professor of Anatomy, Northwestern University Medical School and Frederick A. Coller, Professor of Surgery, University of Michigan Medical School.

C. B. McV.

Preface

THE HERNIA PROBLEM IN GENERAL

TO UNDERSTAND the fundamental defect in any hernia, it is absolutely necessary for the surgeon to know the basic anatomy of the region involved and yet it is frequently apparent at the operating table that the surgeon has only the vaguest idea of the anatomy of the region in which he is working. Because the transversus abdominis layer is all important, and because one sees only isolated areas of it in the conventional anterior cadaver dissections, the *Frontispiece* is presented to show the extent and conformation of the transversus abdominis muscle and aponeurosis; this can only be accomplished in a posterior view of the abdominal wall. It should be an obvious fact that when the innermost musculoaponeurotic layer is perforated, a hernia exists, and conversely, if the transversus abdominis muscle and aponeurosis with its attached transversalis fascia remains intact that a hernia of the abdominal wall is impossible. All too frequently in the conventional anterior approach the strategic importance of the transversus abdominis layer is not realized by the surgeon because his attention is consumed by the more obvious and superficial musculoaponeurotic laminae. As the first step in the hernioplasty the surgeon should so plan his operation that the anatomic structure of the transversus abdominis is returned to normal.

It should be further understood that the respiratory diaphragm and the pelvic diaphragm form an integral part of this same layer although named differently. Also, the transversalis fascia, the infradiaphragmatic fascia and the superior fascia of the pelvic diaphragm are all the same fascial plane with regionally different names. The endopelvic fascia is simply the transversalis fascial layer turned upward upon the viscera that perforate the pelvic diaphragm; an analogous situation exists where the esophagus perforates the respiratory diaphragm.

The word fascia is so loosely used in surgical parlance that it seems pertinent to define a fascia and especially to differentiate a fascia from an aponeurosis. A fascia is a layer of areolar fibers; and the fasciae are disposed as sheets of tissue throughout the body where they invest muscles, neurovascular bundles and parenchymatous organs. There is no organized arrangement of the fibers and regionally the fasciae are modified by the demands of the body, varying greatly in thickness and in their content of fat. In places they may even contain smooth muscle fibers or elastic fibers and in places a fascial plane may be converted into an aponeurotic lamina by virtue of muscular origin or insertion, e.g. the intermuscular septa of the thigh or the so-called lumbodorsal fascia. In the embalmed cadaver they may appear to be tough, resistant membranes but in the living subject they have very little tensile strength unless reinforced by aponeurotic fibers. An aponeurosis on the other hand is a flattened tendon with collagenous fibers disposed in organized bundles; its tensile strength is great and directly proportional to the number of fibers per unit area. The aponeurosis (tendon) of a muscle has as many fibers as the muscle has muscle fibers. In the abdominal wall, the resistance to herniation is dependent upon the strength and disposition of the musculoaponeurotic fibers and not upon the fasciae. The rectus sheath, so commonly referred to as a fascia, is a complex interdigitation of aponeurotic fibers of insertion of the three anterolateral abdominal muscles and not a fascia, although these aponeurotic plates are invested by fasciae.

Whereas the transversalis fascia is routinely mentioned in hernia discussions, it should be pointed out that the transversalis fascia alone is a layer of extremely variable thickness and with very little intrinsic tensile strength. By definition, the transversalis fascia is simply a muscle fascia investing the inner or abdominal

aspect of the transversus abdominis muscle and aponeurosis, and differs in no special way from any other muscle fascia. In some slender, athletic individuals, especially in the inguinal region and especially in the cadaveric state, the preperitoneal connective tissue may be almost totally devoid of fat and appear as a substantial fascial plane. It is undoubtedly this characteristic of the preperitoneal connective tissue in the inguinal region that has led to the confusion in nomenclature; the important point, however, is that this layer is worthless in the repair of hernias.

In the *Frontispiece* the transversalis fascia has been removed to show in detail the muscular and aponeurotic fibers of the transversus abdominis and the respiratory diaphragm. Acquired hernias, incisional hernias excepted, represent a separation of these fibers and surgical correction of the hernia should take into consideration the lines of contraction of the muscle fibers, i.e., the line of closure should carefully parallel the direction of the musculoaponeurotic fibers and not be at right angles or an oblique angle to these fibers. If this principle is violated, muscle pull will tend to cause a dehiscence of the wound. Furthermore, sutures tend to pull out from between the cut ends of the aponeurotic fibers when the line of closure is perpendicular to these fibers; the investing fasciae and the variable decussation of the aponeurotic fibers are the only features that prevent this from happening routinely. Further, any abdominal incision that accomplishes closure across the lines of muscle pull and relies upon the healing scar to withstand this muscle pull is potentially a candidate for the development of an incisional hernia because eventually the scar will stretch and attenuate. The advocates of the routine use of the vertical abdominal incision cannot be fully cognizant of this view of the abdominal wall or the structural composition of the rectus sheath.

In considering this posterior view of the abdominal wall and before the hernias are considered individually, it is well to realize that traumatic diaphragmatic hernia, epigastric hernia, semilunar (Spigelian) hernia, direct inguinal hernia and lumbar hernia are due to the acquired protrusion of parietal peritoneum through and between the musculoaponeurotic fibers. Esophageal hiatus hernia, umbilical hernia, indirect inguinal hernia, femoral hernia and obturator hernia are due to a congenital defect in the musculoaponeurotic apparatus. As this latter group of hernias enlarge, they displace musculoaponeurotic fibers in the same manner as the first group so that their surgical repair presents an identical problem. In general then, after disposal of the hernial sac, the hernial defect should be closed along lines that parallel the musculoaponeurotic fibers of the layers concerned. Small incisional hernias can be repaired according to this principle by dissecting out the individual layers, but large incisional hernias in a vertical incision defy anatomic repair. In this type of hernia there is actual retraction of cut aponeurotic fibers with a fixed contracture of the corresponding muscle fibers. The defect is too large for redevelopment of the layers with an anatomic closure and even when the margins of the vertical defect can be approximated it is always under extreme tension, and the same muscular pull that caused the hernia in the first place will continue to act and attempt to separate the closure. Aponeurotic ("fascial") grafts, aponeurotic suture material and, more recently, the addition of wire mesh are at best only a makeshift in an attempt to solve a problem to which there is no wholly satisfactory solution.

The only possible solution to the large incisional hernia problem is prophylactic, in that if the vertical rectus incision were abandoned there would be no serious difficulty in repairing the incisional hernias that occur in transverse incisions. Although the small truely muscle and aponeurosis splitting incision that is used for appendectomy cannot be used for the more major abdominal operations because of inadequate exposure, the long transverse incision incises a minimal number of musculoaponeurotic fibers as compared to the vertical incision which incises all of the fibers for the length of the incision. An important feature of the long transverse incision if properly made is that none of the musculoaponeurotic fibers of the transversus abdominis layer are severed, and this is the

most important of the three anterolateral abdominal musculoaponeurotic plates in the prevention of incisional herniation. One or both rectus abdominis muscles may be sectioned with impunity. The transversus abdominis pull is directly transverse in the mid-abdomen and the resultant of the actions of the external oblique and internal oblique muscles is also transverse so that an incisional hernia in a transverse incision never offers a very wide defect to be approximated and it can be accomplished in layers without excessive tension.

The use of the inguinal ligament as the anchoring structure in inguinal and femoral hernioplasty has no factual anatomic basis and so will not be presented in this atlas. Although some surgeons will consider this a serious omission, the technique of inguinal ligament hernia repair is so readily available elsewhere that the author feels no obligation to present an operation that he feels is anatomically unsound.

C. B. McV.

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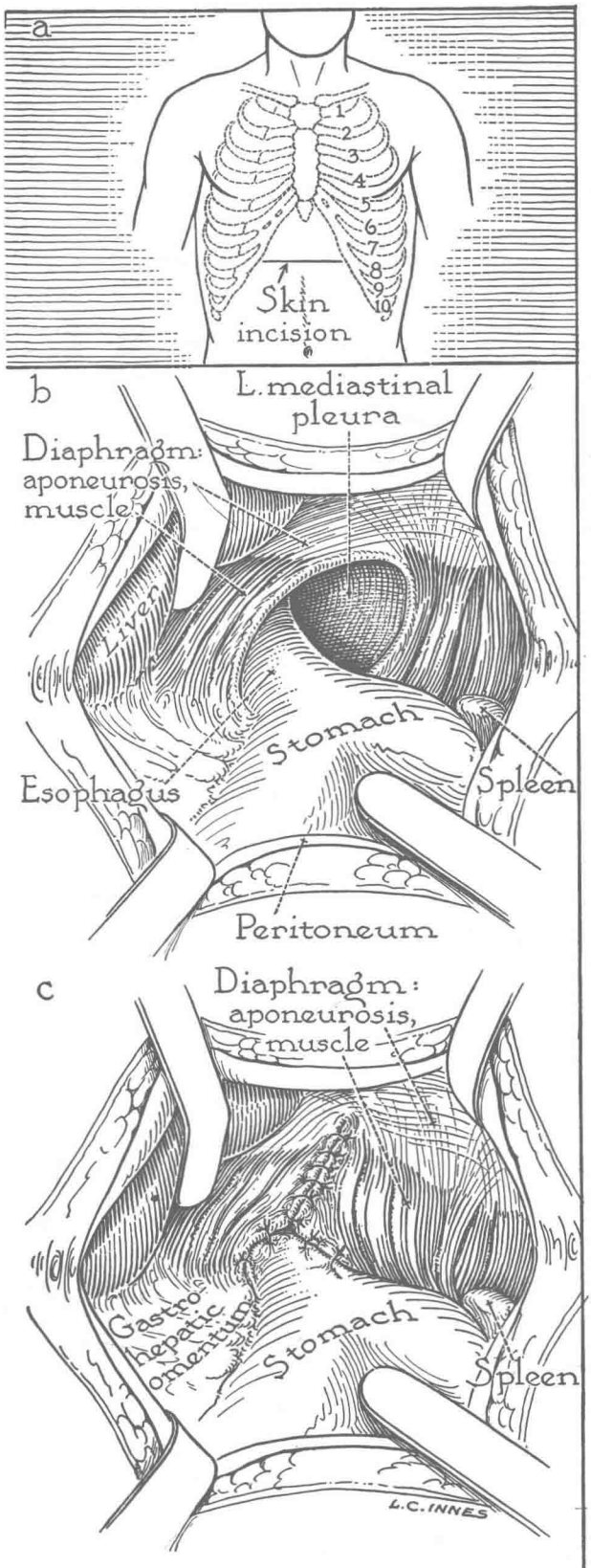
HERNIA



DIAPHRAGMATIC HERNIA

Plate II. Esophageal Hiatus Hernia

a. The incision is transversely placed in the epigastrium at the level of the 8th costal cartilages. The anterior rectus sheath is incised for the length of the skin incision and the rectus muscles transected, ligating the main branches of the superior epigastric vessels with suture ligatures. The fibers of the posterior rectus sheath and the linea alba are then separated and the peritoneal cavity entered on either side of the round and falciform ligaments of the liver which are then cut between suture ligatures. This incision is also used for all types of gastric surgery and abdominal vagotomy, and is therefore frequently used. It is the incision of choice for anatomic reasons (see *Frontispiece, Preface* and section on *Incisional Hernias*).

b. Exposure of the enlarged esophageal hiatus. The triangular ligament of the left lobe of the liver has been cut and the lobe retracted to the patients right under pack and retractor. All packs are omitted from the figure for clarity. The hernia has been reduced and the margins of the hiatus delineated. The diaphragmatic peritoneum has been removed in the figure to demonstrate the musculoaponeurotic fibers of the diaphragm. Care must be exercised to avoid tearing the left mediastinal pleura or lacerating the spleen with retractors or by undue traction upon the stomach.

c. The Hernia Repair. (Closure of the enlarged esophageal hiatus.) The defect has been closed with interrupted medium silk sutures in a direction parallel with the musculoaponeurotic fibers of the diaphragm, pushing the esophagus posteriorly between the crura of the diaphragm. A proper closure of the esophageal hiatus is considered a snug fit for the esophagus and the surgeon's index finger. The abdominal esophagus and adjacent fundus of the stomach are sutured circumferentially to the margin of the reconstructed hiatus to prevent sliding with motion of the diaphragm and leaving the foundation for the recurrence of the hernia. The viscera are allowed to resume their respective positions, the spleen inspected for bleeding and the abdominal wound closed without drainage.

Diaphragmatic Hernia

Esophageal Hiatus Hernia

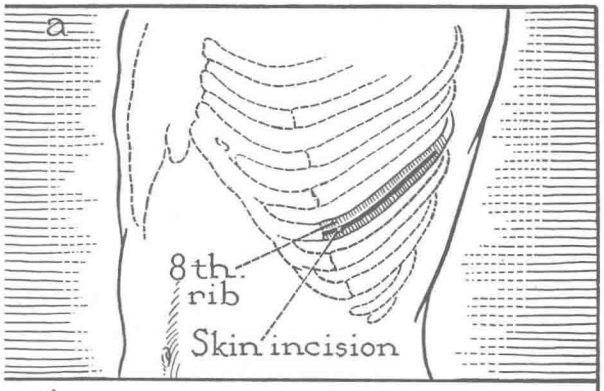
While either the abdominal or the thoracic approach may be used for the repair of an esophageal hiatus hernia, the author uses the abdominal approach in most instances. However, if the hernia is unusually large and the history suggests long duration, or if roentgenographic examination suggests ulceration or carcinoma, the thoracic approach is used. The abdominal approach is through a transverse intercostal incision (Fig. a) and although the level of the incision varies slightly depending upon the width of the subcostal angle, it is usually located between the 8th costal cartilages. In the patient with a narrow subcostal angle, exposure is more readily obtained through a left vertical rectus incision extending up into the angle between the left costal margin and the base of the xyphoid process. Although this incision should probably be used by the surgeon who is unfamiliar with the operation, the author never uses a vertical incision in the upper abdomen because the incidence of incisional herniation in the vertical incision in this location is too high. The substitution of an incisional hernia for an esophageal hiatus hernia is a poor exchange. Occasionally the author has had difficulty in reducing and repairing this hernia through the transverse intercostal incision but the fault was not in the incision but in the fact that the thoracic approach should have been used. When the surgeon discovers that the hernia cannot be safely reduced by the abdominal approach, the transverse intercostal incision at the level of the 8th costal cartilage lends itself well for extension into the left 8th intercostal space and a combined thoracoabdominal operation. This is not the case when the vertical incision is used.

After the incision is made as illustrated and described (Fig. a), the secret of performing the operation with facility is in the exposure (Fig. b). While this platitude is true of any operation it is especially true when one is working at the bottom of a deep hole as is always the case in the abdominal approach to the esophageal hiatus. Good surgical anesthesia is an absolute necessity and as in most major surgical procedures, intratracheal ether oxygen is our anesthetic of choice. If the left mediastinal pleura is accidentally torn or if the abdominal incision is extended into the thorax, the patient and the anesthetist are ready without delay or difficulty. The vicinity of the hernia is provisionally exposed with pack and ribbon retractor on the stomach and the triangular ligament of the left lobe of the liver is incised back to the bare area. The left lobe of the liver is then folded back upon itself, covered with a pack and retracted. There is such variation in the shape of the left lobe of the liver that it cannot always be retracted in the same way but manipulation with the hand will demonstrate the best maneuver; as a rule the lateral edge of the left lobe is turned posteriorly and to the patient's right. The peritoneal reflection from stomach to diaphragm is incised and then by blunt dissection with the finger and traction on the stomach, the hernia is usually reduced with ease and the enlarged esophageal hiatus exposed. A penrose drain placed around the esophagus and used for traction is helpful. Before establishing forceful traction or retraction upon the stomach, the size, position and fixation of the spleen should be carefully determined. If it is fixed to the diaphragm by adhesions it should be freed or manipulated in the retraction very gently. A lacerated spleen or an avulsed segment of capsule necessitates splenectomy to control bleeding and while this is a simple procedure it is an unnecessary addition to the operation of esophageal hiatus hernioplasty. The real danger is not recognizing a lacerated spleen and to avoid this catastrophe the spleen should be carefully inspected again for injury as the last procedure before wound closure.

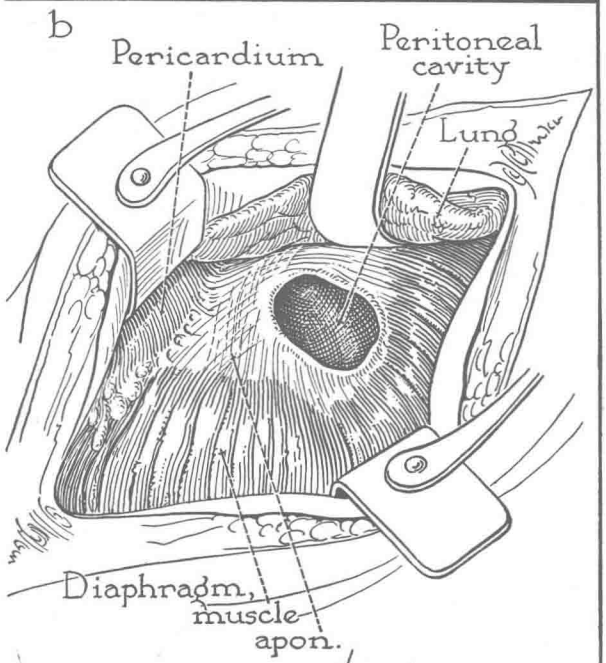
After adequate exposure and reduction of the hernia the margins of the defect are trimmed of fragments of peritoneum and fascia so that the

DIAPHRAGMATIC HERNIA

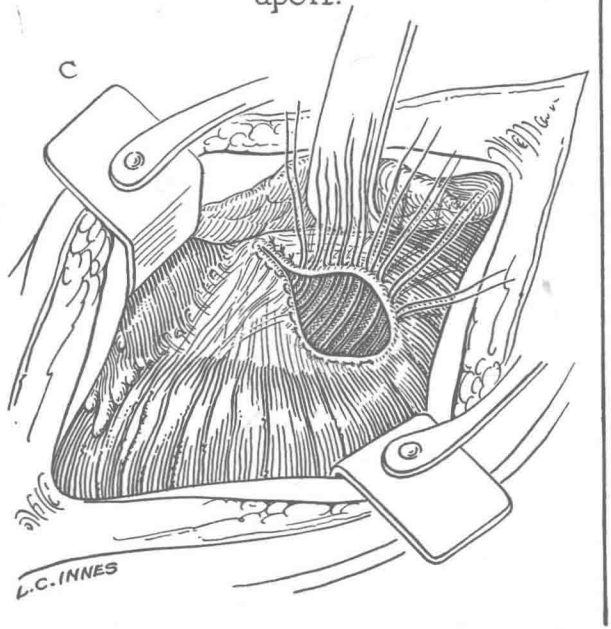
Plate III. Traumatic Diaphragmatic Hernia



a. Schematic view of the left lateral chest wall to indicate the incision for the repair of a hernia through the left leaf of the diaphragm. The skin incision parallels the 8th rib, extends from the costochondral junction to the posterior axillary line and is carried down to the periosteum of the rib, separating the fibers of the pectoralis major and the serratus anterior muscles. The 8th rib is then removed subperiosteally for the length of the incision and the pleural space entered through the rib bed. This gives excellent exposure and the wound is more easily closed than when an intercostal incision is used. The operation is performed with the patient in the supine position with the left upper extremity secured to the overhead operating table frame.



b. Transthoracic exposure of the hernial defect in the left leaf of the diaphragm. The abdominal viscera have been separated from the thoracic viscera and reduced into the abdominal cavity. The attenuated aponeuroticofascial margins of the hernial defect have been excised along with tags of diaphragmatic peritoneum and pleura to reveal the actual aponeurotic margins of the hernial defect. The diaphragmatic pleura is removed in this figure to illustrate the direction of the musculoaponeurotic fibers of the respiratory diaphragm which the surgeon must understand for the correct closure of the defect. Invariably, the long axis of the defect will be in the direction of the musculoaponeurotic fibers of the diaphragm and the closure must parallel these fibers to accomplish closure without tension.



c. The Hernia Repair. Three of the mattress sutures are tied and the remainder are in place ready to be tied. The mattress sutures of 00 silk or nylon evert the edges of the hernial defect on the pleural side and they are placed closely enough to prevent pieces of omentum from protruding through into the pleural space in the postoperative period. In a defect of this size, the phrenic nerve is not crushed but in larger defects it is crushed just above the diaphragm as it still lies between the mediastinal pleura and the pericardium. This is usually done after the abdominal viscera have been reduced but before the repair is started. The chest wall is closed in layers with interrupted 00 silk mattress sutures for the intercostal musculofascial layer after severing the 8th intercostal nerve at the posterior angle of the incision. The fasciae of the pectoralis major and serratus anterior muscles, the subcutaneous fascia and skin are all closed with interrupted fine silk sutures. The pleural space is drained through a stab wound in the 10th intercostal interspace posterolaterally by a catheter that is connected to an underwater seal bottle. The general principles of an open chest operation are observed throughout the procedure, especially the expansion of atelectatic lung compressed by the hernia.