DIAPHRAGMATIC HERNIA

ITS UNSUSPECTED FREQUENCY: ITS DIAGNOSIS: TECHNIC FOR RADICAL CURE

By Angelo L. Soresi, M.D.
of New York
AT PRESENT SERVING IN THE ITALIAN ARMY, SURGEON TO THE MILITARY HOSPITAL IN MILAN

It is the purpose of this paper to call the attention of internists and of surgeons to the frequency of diaphragmatic hernias, especially small ones, because patients suffering from this condition are not properly treated, for the reason that the correct diagnosis is not made, and therefore the treatment is based on curing pathological conditions which do not exist, or co-exist with the diaphragmatic hernia, and the result of the treatment must be, at least, absolutely negative. If diagnosis of diaphragmatic hernia, when a great portion of the stomach, or all the stomach and several loops of intestine have emigrated in the thoracic cavity is made positive, at the present time, with the help of the X-rays, we believe that the diagnosis of small diaphragmatic hernias, which, we repeat, are more frequent than it is commonly thought, and give rise to very serious troubles, has never been made before operation or autopsy. We insist on the frequency and importance of small, very small, diaphragmatic hernias, because unfortunately the subject has received little attention by the internist and the surgeon. This lack of interest is not easily explained, because diaphragmatic hernias give rise to so many complicated and serious symptoms, which if not properly attended to, will lead the patient to an unfortunate life and premature death. That little attention has been paid to the subject of diaphragmatic hernia is proved by the fact that text books, even the ones devoted exclusively to diseases or surgery of the abdomen, either do not even mention the subject of diaphragmatic hernia, or devote only few lines to it. Yet diaphragmatic hernia is a condition requiring immediate surgical intervention, if the patient is to be cured and his life preserved. In fact, if the diagnosis was made at the very beginning, neither congenital nor traumatic or acquired diaphragmatic hernias would cause long useless suffering and later endanger the patient's life, on account of the actual and probable troubles caused by the herniated organs, and the difficulty or even impossibility of performing later a surgical operation, that should cure the patient. Because we have not to forget that at the beginning either a congenital or acquired diaphragmatic hernia is in practically all cases easily operated, while later the mass of the herniated organs increases and might not only be strangulated, but acquire adhesions with the thoracic organs which might render a radical cure difficult or even impossible.

The rather small number of cases of diaphragmatic hernias on record

is not due to their rarity, but to the fact that autopsies are made only on a very small percentage of cases and many patients who might have, and certainly have, died, on account of the presence of a diaphragmatic hernia, have been put on record as deceased not on account of the real disease, but on account of some other pathological condition, because the diagnosis of diaphragmatic hernia had not been made *in vivo,* and the autopsy has not been performed; and even the operating table fails to reveal the presence of diaphragmatic hernias, either because, as our cases will prove, the hernia is not thought of and therefore no operation is performed, or because the diaphragm is not properly inspected: the few small and even large diaphragmatic hernias operated, were not operated because the correct diagnosis had been made, but only because the diaphragmatic hernia was discovered on the operating table, to which the patient had been brought for some other supposed pathological condition: let us not forget the fact, that the diaphragmatic hernia was discovered perhaps only because, on examination of the different organs, they were found all absolutely normal and a very careful search made for the discovery of the cause of the pathological symptoms on account of which the operation was undertaken, revealed accidentally the presence of an opening in the diaphragm; if any pathological condition had been found, that would even most incompletely explain the pathological symptoms, very likely the opening in the diaphragm would have been overlooked and the patient would have had an operation that might have been not only useless, but dangerous. In fact, how many surgeons do inspect the diaphragm when they open the abdomen? I believe very few, exceedingly few, if any, and the writer acknowledges that he himself had never carefully and systematically examined the diaphragm, before he had the opportunity and good luck of observing the cases that will be related later and that convinced him of the unsuspected frequency of diaphragmatic hernias and of the absolute necessity of its diagnosis.

It is obvious, that it is absolutely indispensable to make the correct diagnosis, when even the smallest diaphragmatic hernia is present, in order to treat properly the patient, and not do him harm, as it is done when the diagnosis is not made, as was done in two of our cases. Why is diagnosis of diaphragmatic hernia so seldom made? We believe that two are the main reasons, why diaphragmatic hernias, especially the small ones, are seldom diagnosed: the condition is thought to be very rare; there is not a symptomatology peculiar to diaphragmatic hernias except in the cases of large ones. Let us take up these two points: frequency of diaphragmatic hernia and its symptomatology. That diaphragmatic hernias are much more frequent, than they are thought to be, there is no doubt in our mind about this point, but the internist and the surgeon must think of the possibility of the existence of a small diaphragmatic hernia in all cases suffering from obscure abdominal symptoms, as they think of the possible presence of ulcers, adhesions, kinks,

etc., in order to find more often, than at the present time, that a diaphragmatic hernia is the main or an accessory cause of the troubles complained of by the patients. For the surgeon especially it is very important to think of the possibility of the presence of small diaphragmatic hernias and therefore explore carefully and systematically the diaphragm, in all the cases in which a laparotomy is performed, as he explores all the abdominal organs, *and the diaphragm should be carefully explored also, when other pathological conditions are found, that might explain the symptoms that brought the patient to the surgeon, because of the possible co-existence of diaphragmatic hernias with any other pathological condition,* as will be seen in our cases. We do not insist on this point, because it is too obvious that the patient with a diaphragmatic hernia would not be cured, if the diaphragmatic hernia is not first diagnosed and then properly treated.

Symptomatology.—We have stated that small diaphragmatic hernias are not diagnosed, because they have not a symptomatology of their own: perhaps it would be more correct to state, that we do not know yet a symptomatology peculiar to small diaphragmatic hernias, because not having been diagnosed as pathological entities, the data relating to them have not been properly recorded and collected. When we shall get the habit of thinking of the possibility of the presence of small diaphragmatic hernias, we shall be able to make up a symptomatology peculiar to them, that will lead us to the correct diagnosis, as it happens now in other pathological conditions, that in past years were not diagnosed, because their existence was not known or they were thought to be rare, and in order to make this idea clear, we shall only mention ulcer of the duodenum and appendicitis, the diagnosis of which is made with accuracy at the present time, that we are accustomed to think of their existence and have collected and recorded many important data about them, while in past years, and not many years ago, their diagnosis would have been impossible or exceedingly difficult, and therefore was seldom made. The symptomatology of diaphragmatic hernia is quite complex, because it depends on many factors: the point where the continuity of the diaphragm is broken, the organs that pass through the opening from the abdominal into the thoracic cavity: the portions of these same organs; the relations or adhesions that these organs might contract between the various organs passing through the diaphragm or the organs situated in the thorax, or with the diaphragm itself: the permanence of the herniated organs above the diaphragm: the compression that the diaphragmatic opening might make on the organs herniated: the pulling of the herniated organs on the portions of the same organs that remain in the abdomen: the disturbs that the herniated organs might cause to each single thoracic organ, or to some of them, disturbs which vary according to the position of the patient, that is, whether he is standing or lying down, or on the back, or on the abdomen, or on the left or right

side; to his taking drinks or food, either liquid or solid, cold or warm, to his work, to his emotions, to his temperament. It is sufficient to think of how a diaphragmatic hernia would affect a dispeptic or neurasthenic patient, according to the conditions mentioned above, to make it clear, that it is impossible to fix at the present time a symptomatology peculiar to the existence of a small diaphragmatic hernia. We use intentionally the expression small diaphragmatic hernia, because the large ones are easily diagnosed, when their existence is suspected, by the classical signs of tympanism in the thorax and with the X-rays, and because the small ones are the very ones which give rise to serious troubles, which are wrongly diagnosed and therefore not properly treated, and which are not diagnosed yet even with the help of the X-rays. In fact, while the X-rays are making the diagnosis of large diaphragmatic hernias very plain and easy, they have not given any help in some cases of small ones; on the contrary, they have even lead to a wrong diagnosis, by their supposed and apparent negative findings. Indeed, a small opening in the diaphragm through which a very small portion of the stomach might pass, cannot be diagnosed always with the X-rays, because, when the barium meal fills the stomach, no barium might have entered the herniated portion, or the portion itself at that moment was not herniated, and even the air bulb might not show any appreciable change, or as it has happened, the barium filled portion is mistaken for a diverticulum of the œsophagus. So we can state that the diagnosis of small diaphragmatic hernias can give rise to a complex of symptoms, which at this time cannot be properly classified, because the cases on record are few, and which depend on the conditions we have mentioned above; that not even the X-ray can confirm or deny the existence of small diaphragmatic hernias; that at the present time the proper conduct to follow in regard to diaphragmatic hernia, is to think more of the possibility of its existence, alone or associated with other pathological conditions, and to think of it especially in obscure abdominal cases, where repeated examinations of the different organs and their secretions fail to reveal any conditions that can explain the symptoms complained of by the patient: that the surgeon should examine systematically and carefully the diaphragm in every case in which he performs a laparotomy, especially when he operates on patients with symptoms which are not completely explained with the pathological condition, which he thinks called for operative intervention. These symptoms are quite complex and can go from a feeling of heartburn that disturbs the digestion, to symptoms related to the heart, to the lungs or both, to the difficulty in taking long breaths, to occasional vomiting, to vomiting occurring after every meal, or only after taking certain kinds of food, or taking either hot or cold drinks; to the most severe symptoms on the part of the stomach, especially when adhesions between the stomach and the opening in the diaphragm take place, or when the stomach is pinched or strangulated by the diaphragmatic open-

ing, to difficulty in swallowing, and to many other disturbs that might arise on account of a special hernia and of the temperament, habits, profession, emotion, age, sex of the patient. How could anyone outline the symptomatology of a small diaphragmatic hernia in a nervous pregnant woman, for instance? We only present the problems arising from all these conditions, because in order to discuss them competently, one should have had the occasion of studying a great number of patients with diaphragmatic hernias; we must and shall feel satisfied, if we have stimulated the medical profession to a more thorough study of the subject and have contributed to develop a rational technic for the complete treatment of diaphragmatic hernia.

That the subject of diaphragmatic hernia is worth of any attention the medical profession might pay to it, is proved by the cases which we report, which although few in number, show clearly that the diagnosis of diaphragmatic hernia would have prevented a useless operation in two cases and in all three it was essential in saving the patient's life.

CASE I.—Miss M. E., aged nineteen, girl poorly developed and rather anæmic. Her history is one of long suffering; dismenorrhœa, constipation, indigestion and severe pain in the abdomen, the nature of which the girl cannot explain better than by saying that she suffers every time she has her menses, that she had once a very severe pain in the right side of her lower abdomen, that she had for a long time a dull pain over there, that she suffers from indigestion and constipation, that at times she can not breathe, that she feels like crying all the time; in fact, she is a rather neurotic subject, discouraged and very melancholic. A year previously she finally submitted to an operation, because of the pain in the stomach and in the lower abdomen, of difficulty in digestion, and occasional vomiting. It seems from the account obtained, that the surgeon did not find anything else but a right ovarian cyst, which was removed and thought to be the cause of all the patient's troubles. For a few weeks after the operation the patient felt better and was greatly encouraged, because her menses were twice much less painful than previously. When she began to try to live a normal life, she felt the same troubles she was suffering before the operation; grew terribly discouraged, because all the doctors she consulted stated that there was nothing the matter with her stomach, that she was nervous and so forth, all putting the cause of her troubles on the nervousness and constipation. When seen by the writer she complained specially of pain in the lower abdomen and pain all over her chest and stomach. Repeated examinations with the X-rays and test meals failed to reveal any pathological condition of the digestive tract, but a certain delay in the emptying of the stomach, and her troubles were attributed by the writer to adhesions that might have formed on the abdominal organs following the operation, and to an exaggerated sensibility and nervousness. We did

not advise another operation, thinking that it would be better to have the girl sent to the country and try to build her up and improve her general condition. The advice was followed and as no improvement was noted, the girl insisted on being operated again and see what was the matter with her. On opening the abdomen along the former incision we noted that there were quite a few adhesions present, the omentum was adherent to the abdominal wall and the right adnexa, the stomach had here and there some very slight adhesions with the abdominal wall; we freed all the organs in which adhesions were found and could find nothing abnormal in any of the abdominal organs. After having freed the anterior surface of the stomach from very slight adhesions easily dissected, we noticed, however, that the small curvature did not come in full view and we thought that there might be some adhesions higher up, in reality the stomach seemed to be adherent to the diaphragm and in trying to free it, we felt that our finger did not meet any resistance and had entered a cavity; at first we feared to have been in the presence of a stomach wall thinned by some pathological process and that we had broken with our fingers, so we gave the patient a slight Trendelenburg and saw instead, that there was a gap in the diaphragm around the œsophagus on the left side. The gap was about three centimetres in length, the stomach was adherent to the edge opposite the œsophagus, and the whole diaphragm appeared rather thinned. The stomach was freed and the gap closed following the technic we shall explain below. The after-treatment was directed to build up the patient and improve the conditions of her bowels. An X-ray examination showed that there was a ptosis of the stomach as shown in Fig. 1. We advised, therefore, the wearing of an abdominal belt, paraffine oil, abdominal massage, and active country life for a long time. At the present writing the conditions of the girl are most excellent, the stomach falls still two fingers' breath below the umbilicus, but that does not seem to affect at all her health and the function of the stomach.

CASE II.—R. G., infantry soldier, had been wounded on the Carso about three months previously to the time he was admitted to our service at the Military Hospital in Vercelli. Nothing worth of notice in the past history. The present history, given war condition, was very scanty, the patient said to have been very ill, and unconscious for several days; he was not operated upon, but kept absolutely still. On examination he showed two wounds, one about two centimetres long on the right of the umbilicus, and another smaller and of irregular form between the eighth and ninth ribs along the scapular line. The wound of the abdomen was healed and showed a scar of irregular form, the one on the back was covered by a scab and was adherent to the eighth rib; the scar on the abdomen was rather painful. The patient complained of difficulty in breathing, of pain all over the abdomen and chest upon any physical exercise or even turning around in the bed, difficulty of digestion and occasional vomiting and constipation. We could not

ascertain whether we had to deal with a patient who had been wounded by one or two bullets; from the appearance of the scars it would have seemed that only one bullet had struck the patient, the bullet entering through the chest and coming out from the abdomen; but war experience has taught us that it is not such an easy matter to determine these facts with accuracy. However, on physical examination and from the few lines of history written on the patient's card, it could be established that the patient had certainly suffered from a severe pleuritis and that drainage of the pleura had been continued for about forty days, a piece of cloth having been extracted from the wound and that the wound of the abdomen had also been drained for several days. As we could not find any bullet or piece of shell, we thought that the wounding agent had been single and had passed from the thorax into the abdomen, and on the basis of the pictures obtained, the one we publish being the most typical, and from numerous X-rays examinations made under the screen, we thought we had to deal with a case of hernia of the small intestine into the lesser peritoneal cavity with probable perforation of the stomach and small intestine, resulting in a stomach being formed between these two organs on the posterior surface of the stomach; we held this opinion, for the fact that the vomiting contained a great quantity of bile, although the only stomach content that we could obtain with the stomach tube did not show any bile; we could not examine repeatedly, as we would have liked to do, the stomach content, because the patient stated that he could not stand the swallowing of the tube, and indeed, we had to discontinue using it, because the patient did really suffer from its use; and we thought that, anyhow, our reasoning was logic and congratulated ourselves on the beautiful and accurate diagnosis we had made. On operation, however, conditions were found to be quite different; there were strong adhesions between the wound, the omentum, the colon and some coils of the small intestine, there were adhesions between the coils of the jejunum, some coils of which were really found in the lesser peritoneal cavity adherent to the posterior surface of the stomach, but without any communication between them; the upper pole of the stomach was adherent to the diaphragm and a portion of it closed a gap in the diaphragm of about three centimetres. All the organs were freed, and the diaphragm closed with the technic we shall explain below. The patient left the hospital in good condition and able to eat and digest easily the ordinary soldier's food, still complaining of slight pain in the thorax and some difficulty in breathing, which naturally can be explained with the wound of the thorax and the following pleuritis.

CASE III.—G. A., infantry soldier, aged twenty-one, nothing in past history, wounded on November 18, 1917, at the left of the xiphoid, no exit of the wounding agent. Patient lost consciousness immediately and was unconscious for about thirty hours: remembers that on regaining consciousness he was loosing great quantities of

blood from the mouth and from the wound, and had continuously the impression of choking, which impression was increased while he had coughing spells, which would bring out more blood from the mouth. Around midnight of the nineteenth he had a more severe spell of coughing and had the impression of being completely choked by something pressing on the inside of his chest and abdomen; he vomited then the food that he had eaten the morning before being wounded, that is, about thirty-eight hours after the food had been eaten. The effort made him faint and when he regained consciousness in the morning he was told that during the night he had been given several injections (probably saline hypodermoclysis and camphorated oil). He began to feel somewhat better, kept loosing blood from the mouth for five days more, and from the wound, which was packed with gauze, for about ten days. The sputum then was mixed with blood for about ten days, and the wound secreted bloody pus. The patient was transferred to a base hospital when the wound healed; was examined with the X-rays, nothing abnormal was found and the patient discharged with a leave of convalescence on the 23rd of December. The patient went home, very weak and pale and kept an almost complete milk diet, because if he ate any solid food he would have feelings of indigestion and heart oppression, relieved only by vomiting. During his stay at home the patient had temperature up to 39.6 so that he went back to the military hospital and the fever continued until about the end of January, 1918. Patient was without fever for two weeks and then had again temperature up to 39 for about 20 days more. He always complained of pain in the abdomen, indigestion, some constipation, some painful cough, and especially of pain around the heart: the pain was so severe, that mustard plasters were applied to the chest over the heart and seemed to have given some relief; the diagnosis made was bronchitis and pleuritis. The patient failing to improve was sent in April to the observation hospital in Milano, where he was thoroughly studied by competent physicians who submitted the patient to the X-rays, which revealed the presence of a small fragment of shell in the upper left region of the abdomen, postums of severe pleuritis and slight dilatation of the heart with cardiopalmus. The patient was given again a convalescence leave of three months, but he returned to the hospital before his furlough was ended, because he could not eat anything solid without vomiting and was loosing flesh and strength, and complained even more than at any previous time of pain in the heart region and inability of doing even the slightest physical exercise. The patient was told that he was too nervous and was advised to take a complete rest, resort to milk diet exclusively and live in the country: he refused to accept the advice, insisting on being admitted to the hospital and undergoing a surgical operation for the removal of the fragment of shell (which he thought was causing all his troubles). He was admitted again to the hospital and in July sent to the surgical division. There the patient was kept several

days and thoroughly examined. The X-rays revealed the presence of a fragment of shell in the upper left side of the abdomen and some abnormalities in the shape of the stomach; so at the end of July the patient was operated by a very competent surgeon, who removed the small fragment of shell of the size and form of a grain of Indian corn, situated between newly formed adhesions behind the small curvature of the stomach, and freed the stomach, which then showed itself quite dilated, from a newly formed band that divided it practically in two halves. The patient failed to get any benefit from the operation, and the physicians in charge in consultation with others, thought that the extreme nervousness and excitability of the patient and probably a paresis of the stomach, due to the wide dilatation found at the operation, were the causes of the present precarious conditions of the patient and though it advisable to perform a gastro-enterostomy, as a drainage operation. The patient having consented to have anything done that would relieve him, it was decided to perform the gastro-enterostomy. The writer saw the patient ready for the operation of gastro-enterostomy in the first Surgical Division of the Ospedale Militare Principale of Milano, while he was substituting the chief of the service Professor Mariotti, to whom he wishes to express his gratitude for having given him all the opportunities to study the case and allowed him to operate on the same, with his invaluable help and assistance.

Before the operation the patient was in exceedingly poor condition, terribly excitable and nervous, and practically a living skeleton. Repeated X-ray examintaions made by the writer showed the conditions demonstrated in Fig. 3, and at the operation the condition of the abdominal organs were such as the ones reproduced in the drawings represented in Figs. 4 and 5. The portion of the herniated stomach was slightly adherent to the pericardium and to the edges of the opening in the diaphragm: was freed with blunt and sharp dissection associates and the gap closed with the technic explained in other part of this paper. Recovery uneventful and complete; stomach slightly ptosed; general conditions most satisfactory, the patient having still some slight pain in the chest and slight tachycardia on physical exertions, but feeling otherwise perfectly well and being able to attend to military duties.

COMMENT ON CASES REPORTED

It seems to us that our statements that diaphragmatic hernia is more frequent than it is thought to be, and that its diagnosis is essential for a rational treatment of patients, who might suffer also on account of some other pathological condition, beside the diaphragmatic hernia, are substained by the cases reported which seem to us very instructive. In fact, in none of these cases the diaphragmatic hernia had been diagnosed, in two not even at the operation, and in the third one (Case II) was discovered *only accidentally by the writer,* so that all these three cases would have probably ended in death, that would never have been attributed to the exist-

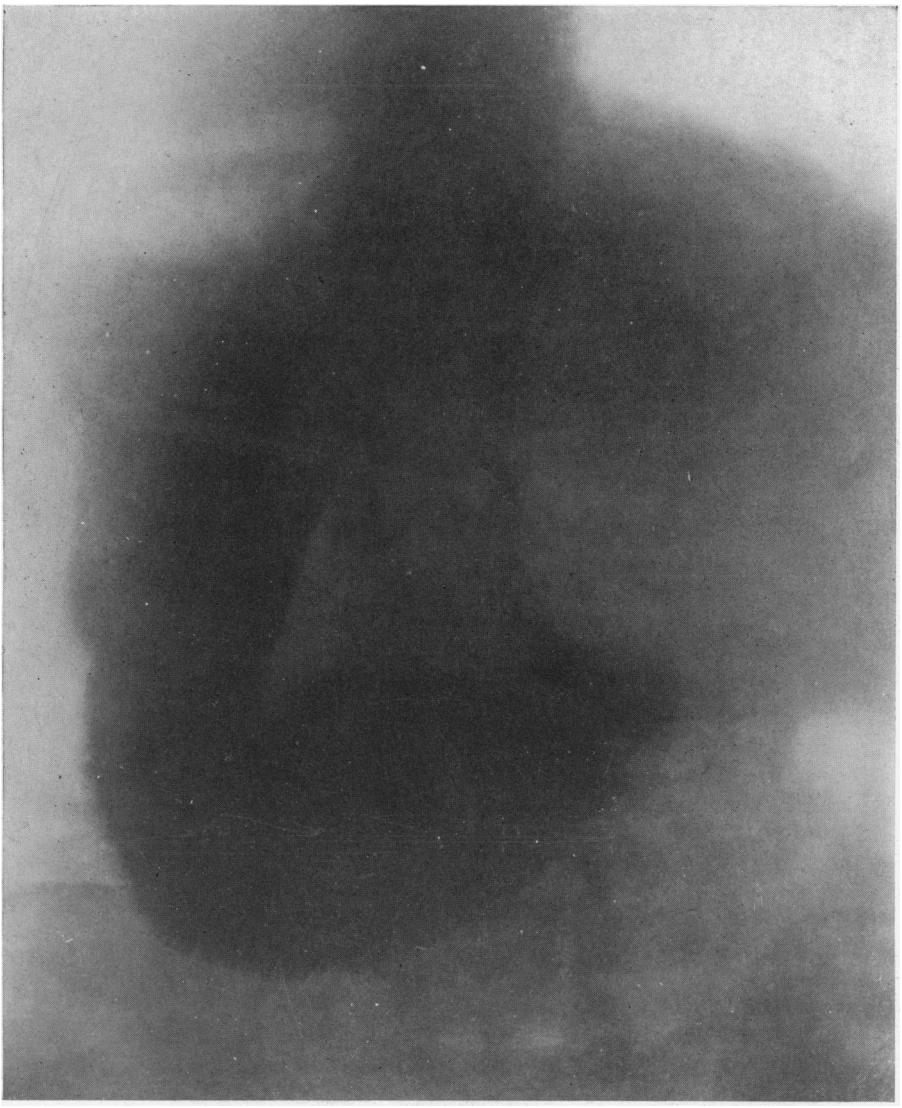

FIG. 1.—X-ray picture of Case I after operation. Only ptosis of the stomach is observed.

FIG. 2.—X-ray picture of Case II. The small diaphragmatic hernia found at the operation does not appear at all, the picture showing only an intimate union between posterior wall of stomach and jejunum.

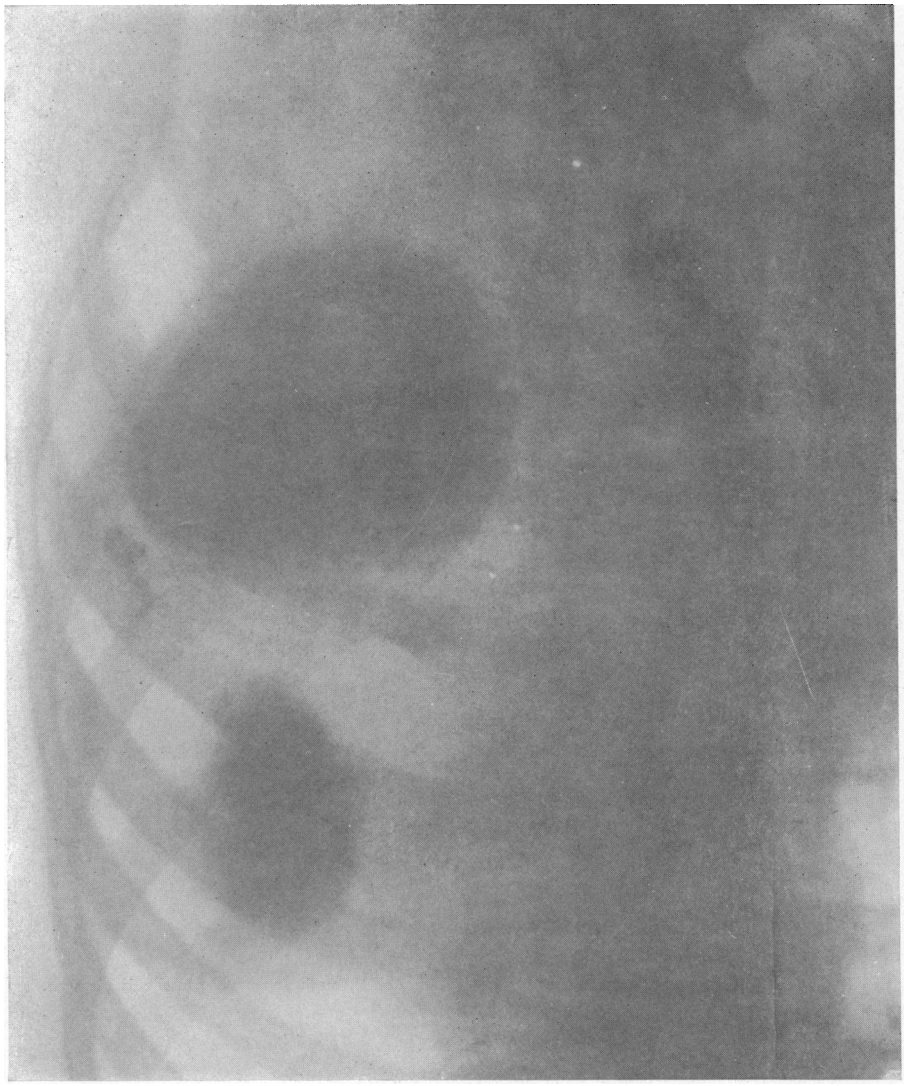

FIG. 3.—In this picture is very evident the portion of the stomach that passed through the diaphragm (Case III).

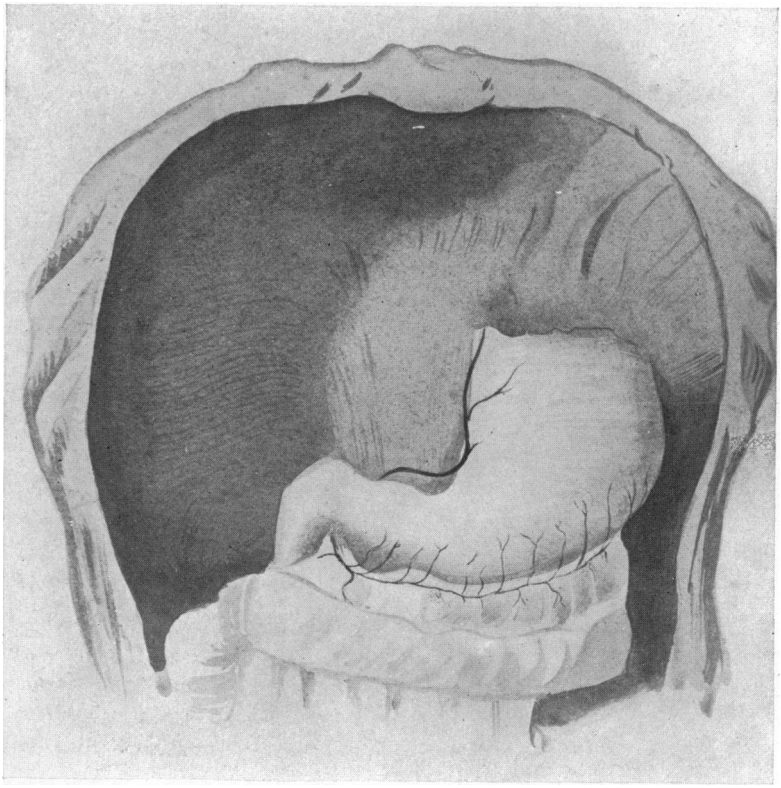

FIG. 4.—Appearance of hernia of portion of the stomach through an opening in the diaphragm.

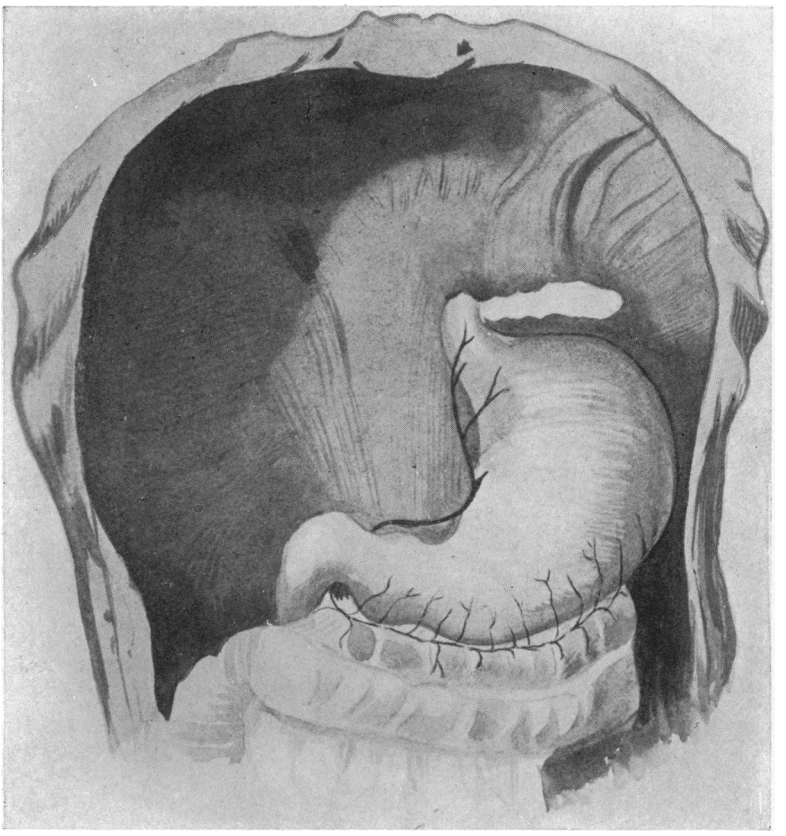

FIG. 5.—Same as Fig. 4, with stomach brought back in the abdominal cavity.

ing diaphragmatic hernia. The second statement, that the diagnosis of diaphragmatic hernia is essential in order to cure patients who might suffer also from other pathological conditions associated with the hernia, and that the surgeon should inspect carefully the diaphragm, when he opens the abdomen, we do not think needs any demonstration, after its absolute necessity is plainly demonstrated by the cases reported. In fact, Cases I and III were physical wrecks, and would have died unless reoperated a second time, and the same could be said of Case II, if his hernia had not been accidentally discovered: Cases I and III had been not only operated upon uselessly, but their troubles were thought to be due to nervousness, exaggerated sensitiveness, neurasthenia and what not; which fact calls for sad reflection on the practical medical science. And we believe that the cases reported are also instructive, because they show that if we have to look for lesions of the diaphragm in all cases in whom there has been a wound around the region of the diaphragm, we should also look for congenital lesions of the diaphragm, which would seem to be also more frequent than we have been thinking.

Varieties of Diaphragmatic Hernias.—Diaphragmatic hernias are either congenital or traumatic, or could result from a collection of pus formed on either side of the diaphragm, that would have destroyed or greatly weakened the diaphragm at the point of its formation. The mechanism by which traumatic diaphragmatic hernias are produced, is easily understood, the diaphragm being torn or cut and the gap resulting from the injury remaining open; or healing imperfectly and then breaking again later.

Congenital hernias do not need to be present at birth; hernias should be considered congenital, when they are formed, because there is a weak point in the diaphragm at birth; this weak point is generally situated around the œsophageal opening; not having the possibility of consulting the literature at the present time on account of war conditions, we do not know if there are on record cases of hernias through the opening for the passage of the aorta or of the vena cava. The diaphragm being formed by the union of several muscles, which merge their tendinous portions toward the centre, hernia might result from any of the points where these muscles and their tendons merge one into the other, either because they do not unite, or because their union being weak, cannot stand the hard work to which the diaphragm is subjected. For obvious reasons diaphragmatic hernias are practically all situated on the left side, because on the right the large mass of the liver forms a kind of protecting pad for the diaphragm. Diaphragmatic hernias differ from other hernias because, for obvious reasons, they are deprived of an enveloping sac.

Diagnosis with the Help of the X-rays.—We have already dealt with the diagnosis of diaphragmatic hernias, we shall only add a few words on the help that the X-rays can lend and how to employ them. When the physician thinks of the presence of a diaphragmatic hernia, a careful

study of the X-rays will in many cases make the diagnosis clear; the herniated organs showing themselves above the diaphragm, these will show more clearly in their pathological position, the larger is the hernia and more voluminous the herniated organs. In small, very small hernias, however, the X-rays will not show any change in the position of the abdominal organs in every case, or and often a diverticulum of the œsophagus will be diagnosed, while one has to deal with a diaphragmatic hernia around the œsophageal opening: in these cases it is sufficient that the physician should think of the possibility of having to deal with a small diaphragmatic hernia, and by examining the patient under different angles and in different positions, might be able to detect the real condition.

When there is suspicion of the existence of a small diaphragmatic hernia that is not revealed by the X-rays examination, we advise the following procedure, which enabled us to make a diagnosis in a case that is not reported, because the patient having refused to be operated, we could not confirm the diagnosis made. The patient is given a mucilage of barium sulphate, made up with syrup of gum or better with tragantha, so as to have a good and uniform suspension of the barium. The patient is examined in the standing position looking at the physician while he drinks the barium mucilage, and the abdomen is massaged: if the hernia does not show itself the patient is examined changing his position from one side to the back, to the other side and again facing the physician. If the examination is still negative, the patient is examined laying on the throcoscope, changing the positions, as done when he was in the standing position; if the examination is still negative, the patient is put on a slight Trendelenburg and instructed to breathe deeply, and then relax the abdominal muscles and by stopping the respiration also relax the diaphragm; if the examination is still negative a massage of the abdomen over the stomach and continued examinations might reveal the presence of the hernia, which had not been seen previously. We advise to follow the technic that we have mentioned, because the barium might not go immediately in the portion of the herniated organ or the organ might not go through the gap at certain moments, and the little hernia is then overlooked, with the added danger to the patient coming from having excluded its existence by an incomplete X-rays examination.

Treatment.—It is obvious that the treatment of diaphragmatic hernia must be surgical; the possible existence of a small or large diaphragmatic hernia is of great interest for both the physician and the surgeon, but once the diagnosis is made or suspected the patient belongs to the domain of surgery. The classical manner of dealing with diaphragmatic hernia is to operate from the chest; we do believe that the chest route should be used only in exceptional cases; the safer and more rational route is the abdominal. In fact, most diaphragmatic hernias will be diagnosed only while operating on abdominal organs, and even if the abdomen had not

been opened, the patient being operated upon through the chest route, the abdomen should be explored in all cases of diaphragmatic hernia, for the possible and probable co-existence of other pathological conditions, either secondary to the hernia or independent from it. It would be a useless and dangerous procedure to open the chest, when the hernia can be completely reduced and its reproduction prevented by operating through the abdomen. The chest route should be reserved for those cases in which the herniated organs have contracted strong adhesions on account of which their liberation is not possible through the abdomen. By the expression their liberation is not possible, we mean to refer to the cases in which the herniated organs have contracted such strong adhesions, that they cannot be freed without causing serious damage either to these same organs, or to the organs with which they have contracted the adhesions. So if the surgeon feels that he cannot easily free the herniated organs without tearing them, or tearing the organs with which they have contracted adhesions, he should stop and open the chest. On the basis of experimental work, we believe that the opening in the diaphragm could be widened in all cases in order to avoid the necessity of opening the chest for the freeing of the herniated organs, because with the technic that we shall describe later, the gap in the diaphragm can be sutured in such a strong and safe manner that there is nothing to fear in widening it. If only slight bleeding should result from breaking the adhesions, the surgeon can do the whole reduction of the herniated organs and the closure of the gap through the abdomen and provide for the drainage of the blood which might ooze out of the lacerated surfaces and collect in the chest, with a stab wound made with a scalpel passed through the diaphragmatic opening and stabbing the chest wall between the two ribs located over the posterior cul de sac of the pleura at its lowest point, and introducing a drainage into the stab wound, which would also provide for the exit of any material that could form on account of the trauma and possible infection of the thoracic organs. If the herniated organs cannot be reduced through the abdomen, the chest is best opened by making an incision of the necessary length through the intercostal space, which will be found to be the most convenient, the ribs being held apart by strong retractors; good retraction will in almost every case avoid the necessity of resecting any ribs. The advantages of the chest and abdominal routes respectively are: by the chest route the whole condition of the herniated organs is seen plainly and can be dealt with in the most thorough and perfect manner; there are in the thorax so many important structures with which the herniated organs can contract adhesions and the freeing of which might be extremely difficult and dangerous, that the importance of the chest route, or better the absolute necessity of resorting to it, cannot be over emphasized when the herniated organs cannot be easily reduced. The advantages of the abdominal route are, that it avoids the necessity of resorting to open widely the

thorax, which procedure, if not as dangerous as it was formerly, is always more dangerous than the opening of the abdomen, which, as said above, should also be opened anyhow, in every case of diaphragmatic hernia, in order to examine the conditions of the abdominal organs and repair any pathological condition that might be present in the abdomen.

In difficult cases the chest and abdominal route can be advantageously associated, the freeing and reduction of the herniated organs being done by the harmonious work of the surgeon and his assistant, as is done, for instance, in some cases of combined abdominal and vaginal or abdominal and perineal work.

We shall not dwell on the general technic of dealing with a diaphragmatic hernia, the operation, however, should be reserved to men who are masters of surgical technic and not to beginners or to amateurs, the difficulties that can arise might require the greatest coolness and mastery of every detail of technic. We only shall spend few words on the technic of freeing the herniated organs.

The main dangers in freeing the herniated organs come from possible shock and laceration of important structures. Shock can be reduced to a minimum or prevented almost completely by avoiding any pulling on the organs that are herniated and on the organs to which the herniated organs are adherent, by operating rapidly and with perfect technic, and by avoiding all unnecessary traumata. The organs which might have contracted strong adhesion must be freed by clean and sharp dissection and not by tearing the adhesions with the finger; clean and sharp dissection done with perfect technic will avoid laceration, unnecessary trauma and pulling of such delicate and important structures as the pericardium, pleura, lungs, œsophagus, diaphragm, stomach, blood-vessels, nerves, intestines, etc. The dissection should always be carried on in such a manner that the less important and more easily repaired organs might be injured; that is, for instance, given strong adhesions between the stomach and the pericardium, œsophagus, etc. The dissection is made very close to the stomach, which even if it should be accidentally opened, can safely and rapidly be closed and repaired. To do this work satisfactorily long incisions are indispensable: they give not only more room but allow a better view of the different organs, which must be under the complete control of the operator, if unforseen and perhaps fatal accidents have to be not only prevented, but possibly repaired, if they should occur, notwithstanding all the precautions the surgeon might have taken. Full view of the organs concerned in an operation for diaphragmatic hernia, is best obtained by giving the patient the Trendelenburg position, when the operation is performed through the abdomen, and putting a pillow under the side of the chest that is not operated upon, in order to widen the intercostal space as much as possible, when the operation is performed by the chest route. The best manner of illuminating the operative field is the use of a frontal lamp, with which the surgeon can really

throw the light where it is needed and avoids the encumbrance caused by lamp post or by the person holding the lamp; we believe the front lamp to be almost indispensable in order to operate in the very best manner on the diaphragm.

Closure of the Opening in the Diaphragm.—The safe and perfect closure of the opening in the diaphragm is obviously of the utmost importance: the suture that is used in approximating the two edges of the opening has to fulfil the following indications: it has to approximate very closely, without tearing them, the edges of the opening; the suture should prevent tearing of the diaphragm later; the suture has to close in the most perfect manner the opening of the diaphragm, especially around the organs that pass through it, œsophagus, cava, aorta, nerves, when the opening is found around them, but without compressing the important organs just mentioned; the suture should not cause the perforation or inclusion in the suture itself of any thoracic organs; the suture should strengthen, if possible, the sutured portion of the diaphragm.

The importance of these points cannot be over emphasized: the diaphragm is a compound of several muscle bundles which unite forming a broad, central, strong tendon; the diaphragm on account of its important function cannot stop its work, when the opening that resulted in the formation of the diaphragmatic hernia is sutured, *the edges have to adhere and form strong and permanent adhesions, not while the diaphragm is at rest, as it could and does happen in other parts of the body which can be put at rest, but while the diaphragm is working.* To emphasize the importance of this point, we can compare the healing of the sutured parts making up, for instance, an epigastric or an inguinal hernia or still better a hernia in the abdominal walls secondary to a laparotomy: the ordinary suture would hold very seldom if the patient immediately after the operation, was not put in a position of complete rest and kept there for several days, but was compelled to strain the sutured sturctures without a moment rest. And the importance of a complete healing and formation of strong union between the edges of the opening in the diaphragm is also made evident by the fact, that if strong union does not take place, a second operation will be necessary; operation to which the patient might object, thinking that the surgeon who has not cured him at the first operation, did not know what his ailment was, or was a poor surgeon, or distrusting all together the ability of surgical science to effect a cure. This last point is very important, because, as we have said before, the diagnosis of diaphragmatic hernia is only seldom made, especially when the hernia is very small and so the patients suffering from it are not properly treated and go from one doctor to another and when finally they are operated upon, if they are not cured, they will loose all confidence in medical and surgical science, and be physical wrecks for life.

The ordinary suture does not close completely the opening in the diaphragm without leaving any gap between the stitches and through

these small gaps the abdominal organs could pass again in the thorax; this is especially true of the gap that is left around the œsophageal foramen, through which the stomach can easily find a way into the thorax again, if it is not most completely and securely occluded. The importance of occluding even the smallest gap, so that the diaphragm has to appear and be a strong uninterrupted structure, is understood, when we consider what we said previously of the continuous uninterrupted working of the diaphragm, which might, and in all probability will, cause any small opening to widen, but certainly not to get narrower and finally become occluded. The importance of not compressing any structure, that is included in the closing of the gap formed in the diaphragm, has only to be mentioned to be appreciated, and the same thing can be said about injury of any thoracic organ. The ordinary suture does not strengthen the diaphragm along the suture line; on the contrary, it weakens it, and the importance of strengthening the suture line is plain, when we think that diaphragmatic hernias either congenital or acquired result always from the fact that the diaphragm became weak or its continuity was interrupted at the point where the hernia has formed, so that this point must be made as strong as it is possible to make it. We hope that the suture we have devised, and that we use also in epigastric hernias, and in hernias of the abdominal wall, will be found useful in the diaphragmatic hernias by other surgeons, as it was found useful and serviceable by us.

Suturing of the Diaphragm.—The suture we recommend because we have found it to be most satisfactory both in clinical and experimental work aims to approximate the edges very closely, in fact, it overlaps them, and to keep them closely approximated. The stitches are put in such a manner, that they cannot tear the tissues, but can stand any amount of strain from the very moment they are put in. In this manner the continuous hard work made by the diaphragm, can be done without fearing that the suture might cut the structures which it has united. Our suture closes up the corners of the gap securely and completely; in fact, we think that it fulfils all the conditions we believe to be essential for a good suture of the diaphragm. The illustrations show plainly how the suture is applied; silk, preferably black, is threaded on a curved needle, the index finger is passed under the edge (Fig. 6) and the needle takes a bite parallel with the edge of about three or four millimetres, the two ends of the thread are caught with an artery forceps. Another stitch is taken along side of the first one and so on until sufficient stitches have been put on both edges (Fig. 7). The corners are dealt with in the following manner: The needle enters the edge under its middle and makes a kind of purse-string suture around the edge, coming out close to the last stitch (Figs. 7, 10 and 11); the same thing is done with another needle in the opposite direction. When all these stitches have been placed (Fig. 7) we have before us a series of stitches parallel to the cut edges: the next

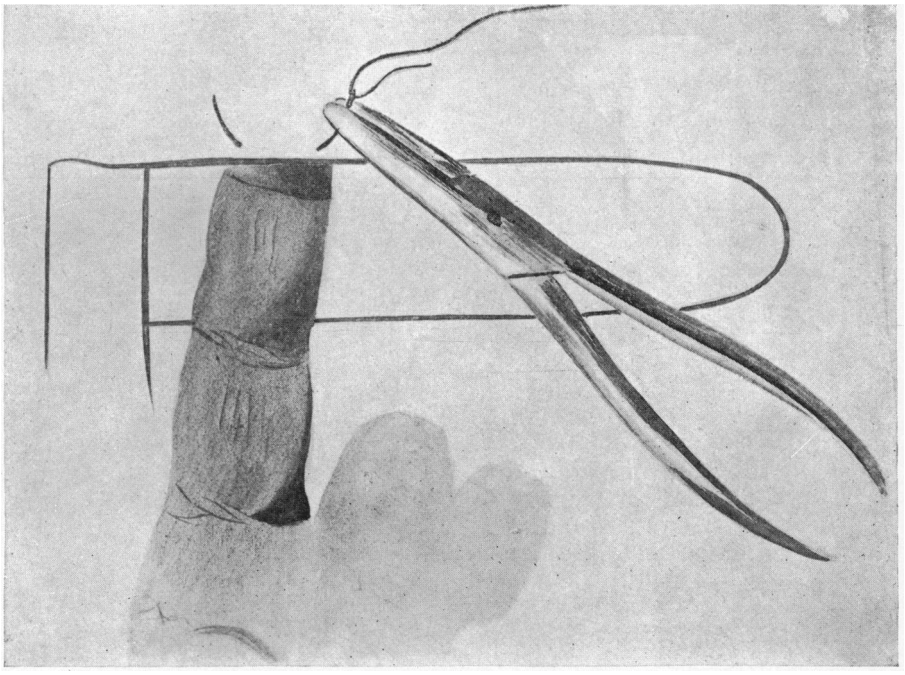

FIG. 6.—Manner of putting sutures that will close the gap in the diaphragm: the index finger preventing any organ to be included in the suture.

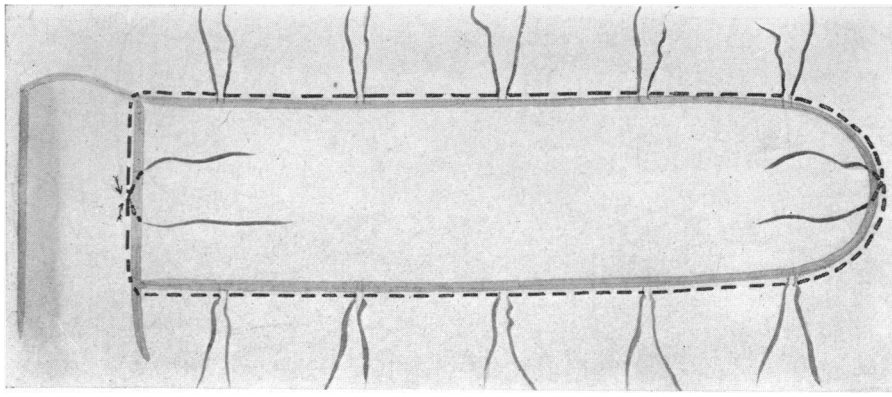

FIG. 7.—Stitches placed all around opening in the diaphragm.

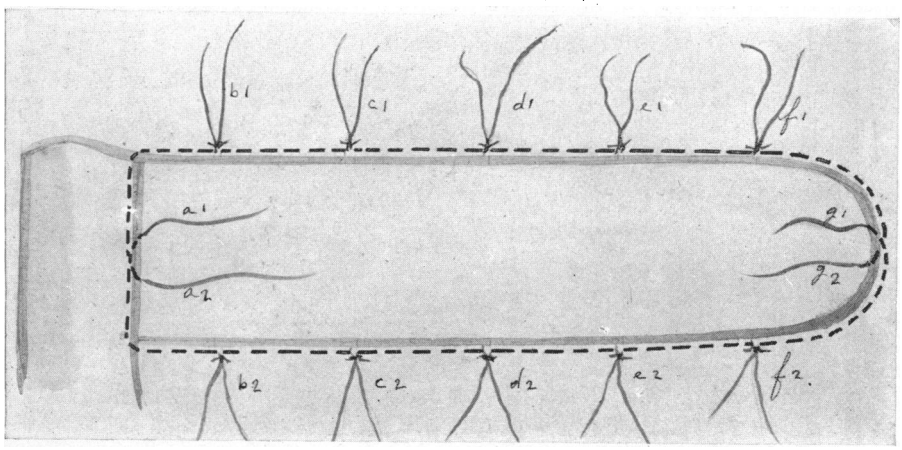

FIG. 8.—Stitches being tied to each other, each thread tied with its neighbor.

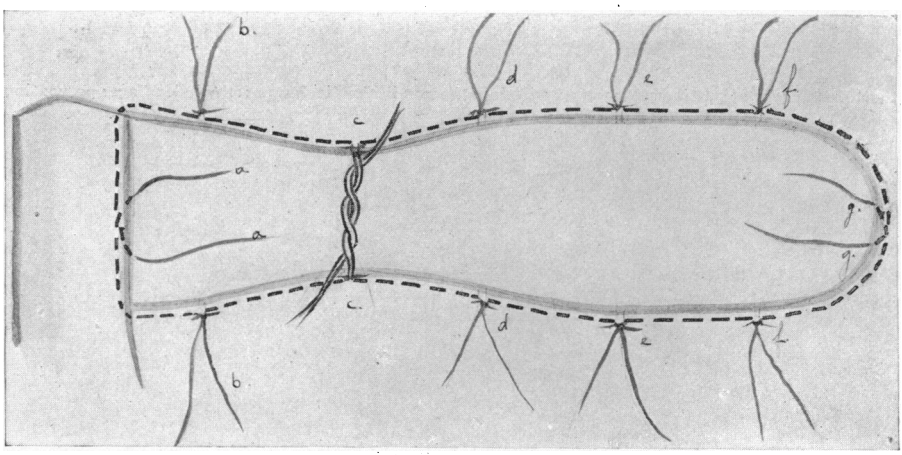

FIG. 9.—Closing gap in the diaphragm by tying together stitches opposite to each other, *a* with *a*, *b* with *b*, *c* with *c*, etc.

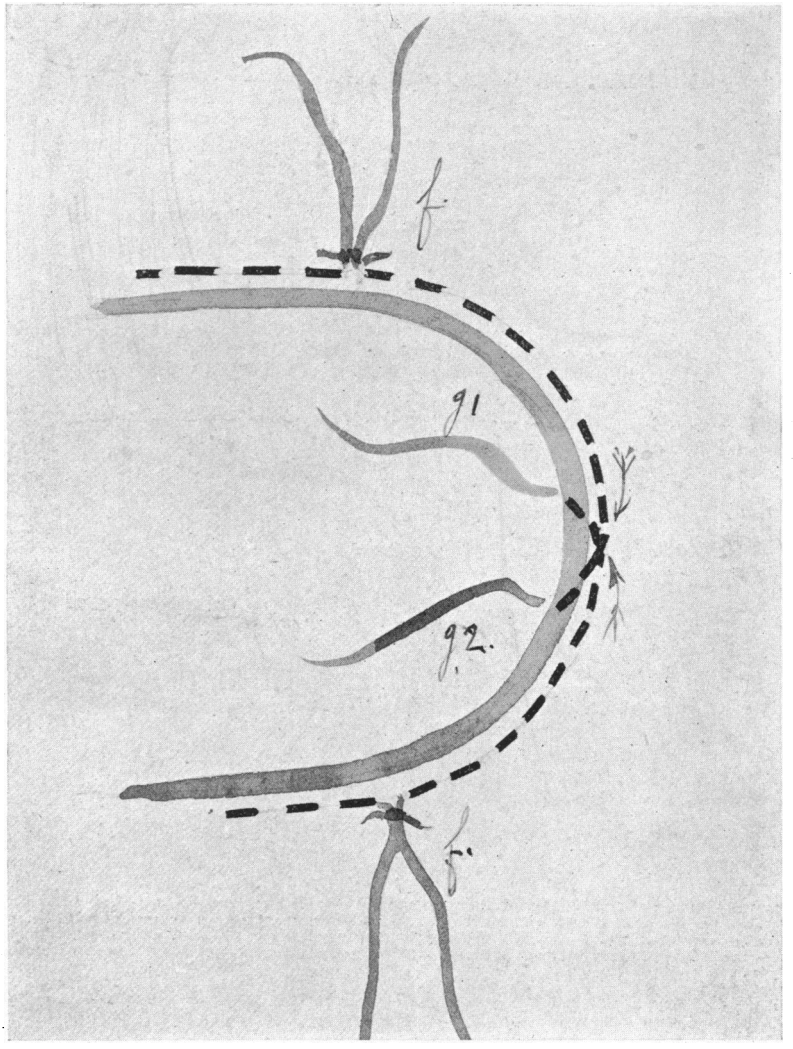

FIG. 10.—Details of how to close corners—note how threads *g1* and *g2* overlap each other, so that when they are tied they approximate securely the parts that have been sutured.

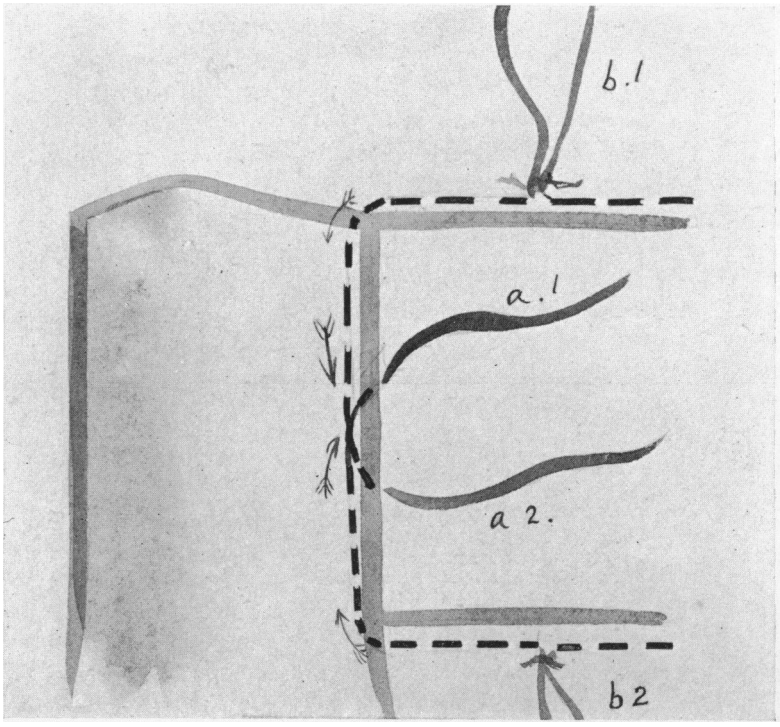

FIG. 11.—Details of how to close diaphragm around œsophagus, threads *a1* and *a2* enter the superficial layers of the œsophagus and are pulled and tied together after stitches b1 and b2 have been tied, so as to occlude completely the gap around the œsophagus; for clearness illustration shows threads entering the lumen, in actual operation this will not happen, if only superficial layers are interested with the suture.

step is the tying of the ends of the stitches which emerge near each other on either side of the gap (Fig. 8). When all the ends of the threads have been tied, all the stitches form a kind of continuous line on each side of the gap, which is then closed in the following easy manner. The ends of the stitches that have been tied together, are tied again with the ends of the stitches of the opposite side (Fig. 9) and the two corners are also securely closed by tying the ends of the stitches that were put around them (Fig. 10).

If the œsophagus or the cava or the aorta are found in the gap of the diaphragm the stitch is somewhat modified, the needle goes through the most superficial layer of the organ that is included in the gap, as shown in the illustration (Fig. 11). Naturally the surgeon must be exceedingly careful in not entering the lumen of the organ, it is sufficient to take in only the very most superficial layer of the organ in order to obtain a perfect closure of the diaphragm around it; in our clinical work we had only the occasion to suture the diaphragm around the œsophagus, but we tried to suture it around the aorta in some experimental work and the results were absolutely perfect. Anyhow, around the organs included in the area, where the hernia is formed, there is always some amount of scar tissue through which the needle can be passed with perfect safety, without any fear of entering the lumen.

It is seen that with the suture we have devised, the gap in the diaphragm is securely closed and no strain is put on any single stitch, the suture being made by single threads which form a continuous line on each side of the gap and pull together without the possibility of cutting the parts that have been sutured, the tension being not on any single stitch, but on the whole line. We recommend the use of black silk, because it is more easy to place properly the stitches, if the silk is black and therefore easily distinguished from the surrounding tissues, than if material of neutral color, such as plain silk, was used; we prefer silk to catgut, because silk will not be absorbed, is incisted in the scar tissue and therefore renders the scar stronger.

After-treatment.—Although the suture we have recommended is strong enough to stand any strain, it will be preferable to instruct the patient to breathe with his chest, so as to strain as little as possible the diaphragm. The patient can be fed as soon as he feels like taking food, but it is advisable not to give any drink or any food until the surgeon is sure that the patient shall not vomit, because naturally vomiting will put a great strain on the diaphragm, strain that can be avoided by witholding drinks and food until the patient shall not vomit. This point is more important in cases of congenital hernias due to weakness in the structure of the diaphragm, because the suture cannot make the tissues stronger than they are naturally, and if the suture is made on tissues with little resistance, it is obvious that the suture might hold, but that the tissues might tear, if too much strain is put on them, and therefore it is advisable to

avoid all unnecessary strain. The patient should be kept in the position that he finds to be the most comfortable, so as to allow the greatest ease in breathing and should get up when he feels that he can breathe without any discomfort.

We may be allowed to suggest a very comfortable dressing that we use in all our laparotomy cases, and which was found especially useful and comfortable in our cases of diaphragmatic hernias. Before the operation we have the patient wear for a few days, when this is possible, a well-fitting, elastic abdominal belt; when the operation is completed we dress the wound in the following manner: we put several layers of gauze over the sutured wound and apply on the abdomen the elastic belt. We do not believe that there is a more rational and comfortable dressing, especially if the patient has been accustomed to wear his belt for a few days previous to the operation. Patients who had been operated twice on the abdomen declared that the comfort they experienced with the simple dressing made with the belt was really wonderful, and comparing the feelings of uneasiness and in some cases of real suffering caused by the other dressings now in use, they all declared that the elastic belt had robbed the operation of some of its most unpleasant features. We advise the patient to wear the abdominal belt for some time at least, because it seems that the stomach has a tendency to fall down in the abdominal cavity, as we have clearly seen in our cases. After a certain time, abdominal massage and deep breathing exercises will be found very useful.

In conclusion we shall recommend again to look for the small diaphragmatic hernias, to persist with the X-ray examinations, when there is some doubt about the probable existence of the hernia, and to inspect carefully the diaphragm in all cases in which a laparotomy is performed in order not to overlook existing diaphragmatic hernias, remembering, that the smaller they are, the more easily they can be overlooked and will give rise to obscure symptoms, which might render quite uncomfortable the patient's life, unless the hernia is properly operated upon.

We believe that the diagnosis is made more easy and the operation best performed if the indications given above are followed.