Delayed Symptomatology in Traumatic Diaphragmatic Hernia with a Note on Eventration*

Agustin Arbulu, M.D., Raymond C. Read, M.D. and Ernest M. Berkas, M.D.

Dearborn, Michigan

In 1579, Ambrose Pare reported a new syndrome, traumatic diaphragmatic hernia with symptoms developing several months after injury. He described the case of a French artillery captain who was shot in the chest by an arquebus. The missile penetrated the sternum, traversed the muscular portion of the diaphragm, and made an exit through the left fifth interspace. The captain’s external wound healed and he returned to duty. Thereafter, he had colic whenever he ate regular sized meals, so he resorted to small meals at frequent intervals. Eight months after the injury, he developed an attack of severe colic; he failed to respond to medical measures and expired two days later. Post-mortem examination showed that much of the colon had passed into the chest through a hole in the diaphragm that would admit only a little finger.

It is the purpose of this paper to amplify on Pare’s observation, that a patient with a history of a serious trauma, who complains of intermittent colic even some years after the accident, may have a correctable diaphragmatic defect. Three cases of traumatic diaphragmatic hernia seen at the Dearborn Veterans Administration Hospital during the past year, and one case that was seen in 1958, illustrate this phenomenon.

A case of eventration of the diaphragm will also be presented, for we have found it difficult to separate this entity from diaphragmatic hernia by roentgen examination. When this relatively innocuous lesion is confused (as it frequently is) with the potentially more dangerous condition of traumatic diaphragmatic hernia, effective treatment may be delayed until too late.

*From the Department of Surgery, Wayne State University School of Medicine and Veterans Administration Hospital.

Case 1:

A 57-year-old man was admitted to the Veterans Administration Hospital, Dearborn, for the fifth time on January 27, 1963, with moderately severe cramping periumbilical pain which had become worse five hours prior to admission. There was associated nausea and vomiting.

His vital signs were within normal limits. There was dullness over the lower third of the right hemithorax with decreased breath sounds in this area. The abdomen was scaphoid with well-healed left flank and suprapubic scars. The remainder of the physical examination was negative. He was treated with nasogastric suction and his symptoms relented within 24 hours.

In 1944, 19 years previously, he had been involved in an automobile accident. He suffered a head injury and was unconscious for three days with associated fractures of the right hip and pelvis and rupture of the urinary bladder. During that hospitalization, the chest x-ray film revealed bowel in the right chest which was shown to be right colon by a barium enema examination. A diagnosis of diaphragmatic hernia was

Figure 1: Admission posteroanterior chest x-ray film, January 27, 1963 (Case 1).
made at that time, but the lesion was not repaired because of the urinary tract problems. Renal calculi were removed surgically on several occasions during later admissions to our hospital, and in 1954, left nephrectomy was performed.

Chest x-ray films and barium enema examination performed on this fifth hospitalization revealed essentially the same findings as those obtained in his 1946 admission (Fig. 1). He was operated upon through a right thoracotomy incision. The liver, gallbladder, hepatic flexure of the colon and much of the small bowel and omentum had herniated into the thorax. The right lung was partially collapsed and adherent to the abdominal viscera. A 15x12 cm. defect through the right leaf of the diaphragm was found (diagram 1, Case 1). Its medial border was ½ cm. anterior and lateral to the inferior vena cava. The abdominal organs were mobilized and replaced beneath the diaphragm after dividing the adhesions that bound them to the lungs. The right lung required decortication in order to fill the space. The postoperative course was uneventful. Chest x-ray films taken immediately after surgery and 12 months later showed the right lung to be completely expanded. At the present time, he is working and is asymptomatic.

CASE 2:

A 50-year-old patient was admitted to the Veterans Administration Hospital, Dearborn, on February 4, 1963, complaining of left flank pain that radiated into the left hemithorax after ingestion of food. The pain was worse if the meal was large. Relief was obtained by induced vomiting. He had lost 23 lb. in weight during the previous year. History revealed that in November, 1954, while driving a truck, he was involved in a head-on collision with a car. He suffered fractures of the skull, left clavicle and left wrist and was unconscious for two days. The physical examination was negative.

The admission chest x-ray film (Fig. 2) was interpreted as showing “an elevated left ear of the diaphragm” and gas shadows in the left side of the chest. An upper gastrointestinal x-ray series was interpreted as showing a “cascade stomach” (Fig. 3). His abdomen was explored through a midline supraumbilical incision. A 10x7.5 cm. diaphragmatic defect was recognized posterolaterally on the left leaf (diagram 1, Case 2). The entire stomach, spleen, tail of the pancreas and splenic flexure of the colon had herniated into the left thoracic cavity. A thin peritoneum-like membrane separated the abdominal organs from the lungs. The diaphragmatic defect was closed with interrupted 00 silk. The postoperative course was satisfactory. Now he is working and feeling well.

CASE 3:

A 67-year-old man was admitted to the Veterans Administration Hospital, Dearborn, on February 10, 1963, with a history of postprandial retrosternal heartburn and stomach fullness for three years prior to admission. The symptoms were made worse by food and were relieved by sitting up, drinking milk and taking antacids. The physical examination was negative. In June, 1960 (three and one-half years before admission) he had undergone esophagogastrectomy and esophagogastrostomy for carcinoma of the lower third of the esophagus. In August, 1961, pyloro-

**DIAPHRAGM**

**Viewed from Above**

**Case No.1**

**Case No.2**

**Left**

**Case No.3**

**Case No.4**

**Right**

**Diagram 1:** Pictorial representation of diaphragmatic defects.
plasty was done, but the symptoms were not relieved.

A chest x-ray film (Fig. 4) showed gas shadows in the left hemithorax and the right cardiophrenic angle. Barium enema (Fig. 5) showed that a loop of transverse colon was above the diaphragm and adjacent to the esophagus. Through left thoracotomy, a 6x4 cm. defect of the diaphragm was found to the right of the stomach remnant that had been pulled into the chest (diagram 1, Case 3). The herniated segment of transverse colon was reduced and the defect in the diaphragm repaired. Care was taken to sew the stomach to the diaphragm. The postoperative course was uneventful and his symptoms were relieved.

CASE 4:

A 24-year-old man was admitted to the Veterans Administration Hospital, Dearborn, on August 10, 1958, complaining of left upper quadrant and left chest pain associated with nausea and vomiting. He had had a similar episode some months earlier, when he was hospitalized elsewhere and improved with nasogastric decompression and parenteral fluids. Nine months prior to admission, he was stabbed with a butcher knife and suffered a chest wound in the mid-axillary line at about the level of the fifth interspace. The skin wound was repaired. He was not hospitalized and no x-ray film was obtained. The chest x-ray film taken on admission to our hospital was interpreted as showing elevation of the left hemidiaphragm (Fig. 6). A diagnosis of “splenic infarct” was made after a tender mass developed in the left upper quadrant. Further study was planned, but he expired suddenly three days after admission. In retrospect, our radiologist sees evidence of bowel above the diaphragm, atelectasis of the left lung and shift of the heart and mediastinum to the right side (Fig. 6). Necropsy revealed that a 1.5 cm. defect in the anterior lateral portion of the diaphragm (diagram 1, Case 4); 285 cm. of small bowel had herniated into the chest. The intestine in the thorax was gangrenous.

A recent case of eventration of the diaphragm illustrates the radiographic difficulties in differentiating this entity from traumatic diaphragmatic hernia.

CASE 5:

A 24-year-old man was admitted to the Veterans Administration Hospital, Dearborn on January 2, 1964, because one month earlier, while applying for a job, an abnormal elevated left diaphragm was detected. His only complaint was an occasional episode of shortness of breath. There was no history of severe trauma. The physical examination was negative except for diminished respiratory sounds in the left lower

**FIG. 2**

**FIG. 3**

**Figure 2:** Posteroanterior chest x-ray film of February 4, 1963 (Case 2). **Figure 3:** Upper gastrointestinal x-ray series (Case 2).
chest. A chest x-ray examination, upper gastrointestinal series and barium enema showed an elevation of the left leaf of the diaphragm with displacement of the stomach and splenic flexure of the colon into the chest (Fig. 7). An abnormal chest x-ray film was first detected when he was 12 years old.

At the time of left thoracotomy, bulging of the thinned central portion of the diaphragm was found. The diaphragmatic insertion was normal at the costal margin; however, muscle extended centrally for only 3 cm. The lung appeared normal and was free of adhesions. The thinned sac-like central diaphragm was partially excised and the defect closed with mattress sutures. A monofilament polyethylene plastic mesh* was used to reinforce the entire left leaf of the diaphragm.

**DISCUSSION**

Traumatic rupture of the diaphragm can follow a penetrating wound, an improperly repaired diaphragmatic incision, or severe blunt injury.2,3,4 In war time, the injury is likely to result from the former; whereas, in civilian practice, rupture is usually the result of motor vehicle accidents, mine falls or industrial injury.5 Inasmuch as there is an increase in the number of survivors, as well as the number of accidents, one can expect to see traumatic diaphragmatic hernia with increasing frequency. This entity should be looked for in all patients with major trauma. When a diaphragmatic defect is found, surgical repair is indicated even though associated injuries are present.

Unexplained attacks of colic should alert the physician to the possibility of diaphragmatic hernia. If the patient has a history of previous major trauma or if the chest x-ray film has been interpreted as showing eventration of the diaphragm, the clinician must be especially aware.

It is of interest that in both of the cases where the hernia was related to blunt injury, a two to three day period of unconsciousness followed the original trauma. Similarly, seven of the 26 cases reported by Grage, MacLean and Campbell6 suffered severe cerebral injury. This common association of brain damage and rupture of the diaphragm can be explained in two ways: (a) blunt trauma severe enough to rupture the diaphragm can also injure the

---

*Usher's Marlex mesh, Davol Rubber Company, Providence 2, Rhode Island

**FIG. 4**

**FIGURE 4:** Posteroanterior chest x-ray film, March 2, 1963 (Case 3). **FIG. 5:** Lateral chest x-ray film after barium enema (Case 3).
The characteristic roentgenogram patterns of traumatic diaphragmatic hernia have been well described by Carter, Giuseffi and Felson and are: (1) an arch-like shadow resembling an abnormally high diaphragm; (2) extraneous shadows such as gas bubbles or other abnormal markings above the usual level of the diaphragm; (3) shift of the heart and mediastinal structure to the side opposite that of the defect and (4) disc or plate-like areas of atelectasis in the lung adjacent to the arch-like shadow. To these signs we would like to add (5) the presence of fluid levels in the affected hemithorax. It is probable that proper interpretation of adequate chest roentgenograms in our cases could have led to an earlier diagnosis in each instance.

The surgical repair of traumatic diaphragmatic injury may lead to thickened visceral pleura. When the herniated viscera have been returned to the abdomen, decortication may be necessary to liberate the trapped lung and permit its complete re-expansion. We believe that better repair can be attained if the area of insertion of the diaphragm in the chest wall is left intact and prefer to use either a thoracic or an abdominal incision or both. Thoraco-abdominal incisions do not seem necessary or advisable.

Anatomically and symptomatically, eventration of the diaphragm can be compared to a direct inguinal hernia, whereas traumatic diaphragmatic hernia more closely resembles the indirect variety or a femoral hernia. Like direct inguinal hernia, one can describe eventration as a bulge of the diaphragm with smooth padded edges, while the appearance of traumatic hernia is that of a defect with sharp markings prone to obstruct and strangulate the herniated viscera. Colic and strangulation are unknown with eventration of the diaphragm. The presence of intact muscle along the costal margins and absence of muscle in the area innervated by the phrenic nerve of Case 5 suggests that nerve palsy may be the cause of eventration.*
SUMMARY

Attacks of colic occurring some time after major trauma may indicate traumatic diaphragmatic hernia. The diagnosis depends upon proper interpretation of the roentgenographic study. Immediate surgical repair of the injured diaphragm with careful decortication of the trapped lung is then indicated. Eventration of the diaphragm, although similar in radiographic appearance to traumatic diaphragmatic hernia, is usually found in patients who do not have a history of major trauma and do not have symptoms of colic.

RESUMEN

Los ataques de cólicos que ocurren algún tiempo después de trauma importante pueden indicar una hernia diafragmática. La inmediata reparación quirúrgica del diafragma lesionado con decorticación cuidadosa del pulmón atrapado está indicada. La eventración del diafragma aunque similar en apariencia radiográfica a la hernia traumática se encuentra en enfermos que no tienen historia de trauma y no dan el cólico como síntoma.

ZUSAMMENFASSUNG

Anfälle von Koliken, die in einigem Zeitabstand nach stärkerem Trauma auftreten, können auf eine traumatische Diaphragmahirnerie hinweisen. Die Diagnose hängt von einer genauen Interpretation der Röntgenbefunde ab. Es ist dann aber auch die unmittelbare chirurgische Behebung des geschädigten Zwerchfelles mit sorgfältiger Dekortikation der befallenen Lunge indiziert. Eventration des Zwerchfelles, obwohl diese röntgenologisch einer traumatischen Zwerchfellhernie ähnlich ist, findet sich gewöhnlich bei Patienten, bei denen sich keine Angaben eines größeren Traumas ermitteln lassen, und die auch keine Symptome von Koliken haben.

REFERENCES


PRECIPITIN TEST IN FARMER'S LUNG

Agar-gel precipitin tests were performed on the sera of 327 United Kingdom farmers who had given a history of exposure to moldy hay, with extracts of moldy hay, Thermopolyspora polyspora, Micromonospora vulgaris, Mucor sp. and Aspergillus fumigatus. Positive reactions in the immunoelectrophoretic test to "farmer's lung hay" (F.L.H.) antigens were obtained in 89 per cent of 205 subjects regarded as having farmer's lung, and, of these, 87 per cent were due to the F.L.H. antigens derived from Thermopolyspora polyspora. These sera gave reactions to all three of the main F.L.H. antigens (A, B, and C) in 42 per cent of cases, to two in 31 per cent, and to one in 14 per cent. The wider the range of the serologic reaction, the greater was the frequency of reactions to the other extracts, the more frequent and severe were the attacks, the higher the degree of clinical sensitivity to the dust of moldy hay, and the higher the proportion of men, presumably because they were more heavily exposed. F.L.H. reactions (Thermopolyspora polyspora type) were obtained with the sera of Icelandic patients with farmer's lung. In 16 patients with farmer's lung due to other vegetable dusts, only 50 per cent gave F.L.H. reactions.

In tests on the sera of subjects who had not been exposed to moldy hay, some having been exposed to other vegetable dusts, no F.L.H. reactions were obtained against extracts of moldy hay in tests on 304 sera, and no reactions (except in five bagasse workers) were obtained against an extract of Thermopolyspora polyspora in tests on 302 sera. Trichloracetic acid fractionation of Thermopolyspora polyspora extract gave a precipitate containing the A and B antigens and a supernatant containing the C antigen. Both fractions provoked systemic and pulmonary reactions in affected subjects in inhalation tests.