Detection of Hiatus Hernia on 4 x 10 Chest Survey X-ray Films

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Ambroise Pare32 “anatomized”*** the first two reported cases of diaphragmatic hernia, published initially in 1564. Two centuries later, another French surgeon, Petit,33 described post-mortem findings in hiatus hernia.*** In 1882, Thoma,41 a pathologist, collected 290 diaphragmatic hernias from the literature: only three of them were para-esophageal. The latter type was thus believed to be very rare.38

As early as 1897, fluoroscopy had been considered potentially useful for the detection of diaphragmatic hernia.37 In 1900, Hirsch16 and Mertens found the first case, revealed by radiological examination. They reproduced a film of the barium-coated, air-distended stomach, containing a recoiled catheter filled with mercury. It made history, even if the autopsy, performed years later, disclosed an eventration.2 Eppinger10 was actually the first to diagnose a hiatus hernia on x-ray films in 1904.

By 1911, 635 diaphragmatic hernias had been published, 11 of which were para-esophageal. Becker3 contrasted the six cases of diaphragmatic hernia suspected on physical examination (during three centuries) with the 13 cases discovered in the first 15 years of the x-ray era. Early literature, debating the differential diagnosis of hernia vera and relaxation or eventration, has been reviewed by J. M. W. Morrison27 and Assmann.2

At a meeting in Boston (1922), L. B. Morrison28 and Healy15 presented 12 hiatus hernias detected during routine x-ray examination of the fundus, originally intended to reveal eventual malignancies. The number was later increased to 32, and finally to 53, which proved that it was not an uncommon finding. In some European textbooks,43 the credit for this goes to Akerlund,1 although he arrived at similar conclusions four years later, in 1926.

Today, the high incidence of hiatus hernia is unanimously accepted.19 It can be seen in 2 to 6 per cent of all barium examinations of the upper G. I. tract.36 A large number of cases, with literary references covering mainly the last few decades, were published by Kirklin and Hodgson.21 The condition is often asymptomatic, having been demonstrated in four out of 300 apparently healthy adults.6

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**Transcription of French archaism meaning autopsied.
***At an early stage, the difference between the common (sliding) hiatus hernia and the rare (rolling) para-esophageal type consists in the location of the cardio-esophageal junction, which in the former lies above the diaphragm, below it in the latter. At a late stage, due to considerable widening of the hiatal ring, the original condition can seldom be identified, and therefore advanced cases are classified in the first group. In this paper, no attempt has been made to separate the two notions. The term hiatus hernia was introduced in 1922 by L. B. Morrison and Healy of Boston.
The first usable apparatus, for what Manoel de Abreu calls roentgenography, was constructed in 1936.

Holfelder and associates\textsuperscript{17} used the method for the first time on a large scale. Its popularity can be evaluated from the number of names received: mass (miniature) radiography\textsuperscript{11,25,26,30,42} mass (x-ray) survey\textsuperscript{5,8,14,23} (mass) chest survey\textsuperscript{7,12} routine chest x-ray\textsuperscript{39} photoroentgen\textsuperscript{12} in France radiophotographie\textsuperscript{18} in Germany Schirmbildaufnahme\textsuperscript{17} in Italy schermografia\textsuperscript{24} in Latin America abreugrafia\textsuperscript{9}.

It is utilized mainly as a screening procedure for pulmonary tuberculosis. Nonetheless, its value in the detection of non-tuberculous and extrapulmonary conditions has been repeatedly emphasized.\textsuperscript{5,8,14,17,24,26,30,42}

A positive diagnosis of hiatus hernia can hardly be made from the postero-anterior chest view alone. Yet, it may be suspected if a supradiaphragmatic fluid level, a gas bubble or a rounded opacity is visualized through the heart shadow, or protruding into either cardiophrenic angle. This finding was described for the first time by Eppinger\textsuperscript{10} and is mentioned in recent textbooks\textsuperscript{24,36,43}. It must be differentiated from many similar appearances, such as due to mega-esophagus, esophageal diverticulum, aortic aneurysm, neurofibroma, other varieties of diaphragmatic hernia, echinococcus, lower lobe atelectasis, mediastinal abscess or tumor, etc. Nemec\textsuperscript{29} has pointed out that in this respect even such trivial changes as dorsal scoliosis or tortuous aorta may prove confusing at times.

Nevertheless, the number of diaphragmatic hernias detected by photoroentgen is insignificant. Often it is totally disregarded,\textsuperscript{5,7,9,11,23,25,26,30,39} sometimes after 100,000 or more examinations.\textsuperscript{4,12,26} When found, the incidence quoted is very low: Trail et al.\textsuperscript{42} discovered 13 hernias and ev- entrations in 250,027 examined; Gould\textsuperscript{14} reported 11 diaphragmatic hernias in 442,252 surveyed; Clark et al.\textsuperscript{8} and Holfelder et al.\textsuperscript{17} had two cases; Spencer and Schaeffer\textsuperscript{40} demonstrated one in 10,661; O’Loughlin\textsuperscript{31} one in 24,615. Kohl et al.\textsuperscript{22} found only one diaphragmatic hernia in a prenatal chest survey of 4,980 patients. Fifteen years earlier, Rigler and Eneboe\textsuperscript{55} had demonstrated 25 hiatus hernias on routine examination of 195 women in the third trimester of pregnancy. The high incidence is probably due

\textbf{FIGURE 1A:} A hiatus hernia may be suspected from a scout film when a supradiaphragmatic fluid level, a gas bubble, or a rounded opacity is seen through the heart shadow or protruding into either cardiophrenic angle.—\textbf{FIGURE 1B:} The presence of a fluid level between heart and spine is highly suggestive of hiatus hernia. Its positive demonstration requires barium filling.
Figure 2: Case K.A., 57, F, 5'4", 160 lbs.—(A) 4 x 5": Ununited, old left clavicle fracture; left ventricular enlargement; rounded retrocardiac mass with vaguely outlined fluid level to the left of the spine. (B) Left lateral: the stomach fundus is seen protruding above the diaphragm, between heart and spine. (C) Right anterior oblique in prone Trendelenburg reveals a recollected body, with gastric folds widely spread through the hiatus.

†The photofluorograms are reproduced from positive contact prints for better visualization of density changes in the cardiac opacity.
to intra-abdominal pressure changes, because seven out of 10 proved cases showed no evidence of herniation on recheck after delivery.

Modern tuberculosis control in mental institutions requires routine chest x-ray film on admission, as well as biannual survey of patients and employees alike. In this hospital, 4 x 10 (stereo) is used for this purpose, questionable and pathologic findings being rechecked on 14 x 17 plates. The various wards are x-rayed by rotation, which provides a continuous flow of films to the reading room, rather than heavy piles twice yearly.

At first, an obvious hiatus hernia was discovered in the survey. As a consequence, more attention was paid to the retrocardiac shadow on the miniature films, and soon cases began to accumulate at the rate of one every eight to 10 days. To the date of this writing, 21 have been demonstrated. Three other patients, two of them males, were unable to cooperate for the examination; their resistiveness prevented filling of the stomach with barium by catheter, a last resort in several cases.

The patient population fluctuates around 4,200. No percentages shall be calculated, because of (a) the relatively fast turnover of patients,† (b) the addition of new cases at each survey, and (c) the concentration of older age groups in the hospital's patients which raises the apparent insidence, since hiatus hernia is more frequent after the fifth decade. Only eight of the 21 proved cases were males. This may be due to the prevalence of older females in our mental, as well as in the general, population.

Altogether, our figures are in agreement with the findings of Froman, who demonstrated 58 diaphragmatic hernias over a period of several years in a hospital for the mentally ill with a census twice as large as this institution.

In many of our cases, a lateral chest view, taken after a carbonated drink, revealed a circular shadow with fluid level, located between heart and spine, which we like to consider a highly presumptive sign for the presence of hiatus hernia. Positive proof was obtained routinely in supine Trendelenburg, during barium meal, with or without Valsalva maneuvers. Left and right oblique exposures were taken routinely, to rule out a short esophagus, to evaluate the extent of the herniation, and to visualize eventual recoils of the body.

The reasons for overlooking hiatus hernia on plain chest films (4 x 10 or 14 x 17) are manyfold. They shall be discussed under three convenient headings: the hernia, the film, and the examiner.

In the observation princeps, no adhesions had formed between the herniated organs and the diaphragm. In the light of our present knowledge, this seems to be the rule, rather than the exception. Reduction of the hernia can often be induced by simple maneuvers such as walking, deep breathing, leaning forward, taking a warm drink, etc. Prerequisite for such a "pendular" condition is a wide rent in the diaphragm, or a relaxed esophageal ring. The latter case seems to be quite frequent in the older

†Two died, one was released on family care, one was transferred to another institution, and two additional cases have been discovered among those admitted within the last three months, ending April 30, 1953.
Figure 3: Case I. A., 76, F, 5'1", 140 lbs.—(A) 4 x 5: increased density of soft tissues of neck (goiter); rounded widening of the upper mediastinum; prominent aortic knob; double cardiac contour. (B) Right lateral: retrocardiac supradiaphragmatic fluid level with gas bubble. (C) Postero-anterior view in erect position, after ingestion of thick barium, demonstrates a (pendulous) pulsion diverticulum, emerging at the pharyngo-esophageal junction; the supradiaphragmatic fundus is also visualized.
age groups, particularly in overweight individuals, in which instance hiatal "insufficiency" or "incompetence" would be a suitable name. Obviously, the chest film must be negative, if the stomach was in the abdomen during the exposure. This is why the retrocardiac opacity may alternately appear and disappear on successive views. Two cases were added to our list because the ward was surveyed shortly after lunch. Perhaps the ingestion of a carbonated drink, just before the exposure, would increase the number of hiatus hernias detected on routine (admission) chest x-ray films.

The phoroentgen film has a blue sensitive, high speed emulsion, and retains good tonal qualities and definition, but it can only reproduce what it "sees" on the large sized grains of the screen. Moreover, developing in the x-ray solution will emphasize the contrast, with the intent to "bring out" eventual soft pulmonary shadows, assumed to occur often in early tuberculosis. As a result, the range of densities is shortened, which again decreases the chances of detecting variations in the cardiac opacity. On the other hand, in the overweight, excessive secondary radiation will deposit enough silver to hide everything behind a gray curtain. This goes also for the 14 x 17, in which case a higher penetration, a Bucky or even a stationary grid, might be of help in revealing retrocardiac shadows. However, until recently, anything over 70 KVP was considered unsuitable for chest diagnosis. While high voltage techniques for regular chest films are presently on trial in several places, it is worth mentioning that in 1948, Jaubert de Beaujeu18 had suggested it for roentgenography. He used 180 KVP, 200 MA at 120 cm. focus-screen distance, the exposures being 0.25 to 0.3 seconds for adults, 0.1 to 0.15 seconds for children. Contrary to previous assumptions, if the MAS are kept within reasonable limits, the soft shadows will not be "burned out".

Chest people have sometimes a tendency to limit their evaluation of the thorax film to what is more or less strictly connected with pulmonary disease. A wider outlook is in order. The radiolucent area in that upper rib giving away the diagnosis of a rounded apical mass; the fractured rib labeling a pleural reaction as traumatic; the subcutaneous emphysema proving a bronchial leak in cases of trauma without demonstrable pneumothorax; these are but a few instances in which chest diagnosis will benefit from careful inspection of every highlight and every density, however remote and apparently insignificant. Furthermore, one seldom sees something that he is not prepared to find. Of course, a stomach projected over either lung field will hardly be overlooked, but those are exceptions. The average sized hernia may not be discovered, unless constant alertness is maintained for the possible detection of retrocardiac shadows. After some practice, it becomes part of the routine, like the upward glimpse, intended to avoid the omission of a clavicle fracture.

There is a tendency to multiply the surveys in the population, and to introduce miniature chest films in the admission routine of most general hospitals. Thus, the radiologist and the chest man are in a position to detect more and more cases of hiatus hernia. The reward for such endeavor is under circumstances gratifying. The internist can be provided
Figure 4: Case W. R., 69, M, 5’7”, 150 lbs.—(A) 4 x 5: generalized emphysema; mildly tortuous aorta; retrocardiac gas bubble, without fluid level, to the right of the spine; retrocardiac opacity, without evidence of gas, to the left of the spine. (B) Left lateral: the usual fluid level in the lower mediastinum. (C) Postero-anterior view in supine Trendelenburg: large hiatus hernia containing most of the body of the stomach; double contrast visualization of the greater curvature (rudimentary Hampton technique). The herniated portion of the stomach is recollated, billocated, and twisted. Food is often retained in the proximal segment (projecting to left of spine), and gas was trapped in the distal portion (to right of spine): maybe the unusual appearance on the photoroentgen could in itself suggest a volvulus.
with a valid alternate diagnosis, when the precordial pain of an old gentleman means four to six weeks (coronary) bed rest. Similarly, the surgeon may be warned that his lady-patient will probably continue to complain of postprandial distress even after removal of the gallbladder.

**SUMMARY**

Hiatus hernia, frequently due to hiatal relaxation or incompetence, is relatively common in the pyknic individual over 50. Three cases are illustrated, these being selected from 21 proved hiatus hernias, detected on 4 x 10 chest survey among 4,200 patients of a hospital for the mentally ill.

On a plain chest view (4 x 5 or 14 x 17), the presence of a hiatus hernia may be presumed when a supradiaphragmatic fluid level, a gas bubble, or a rounded opacity is visualized through the heart shadow, or protruding into either cardiophrenic angle. Sometimes, the condition cannot be suspected from the scout film; the reasons for this are analyzed.

Suggestions for a more frequent detection of hiatus hernia from 4 x 5 or 14 x 17 plates include: (a) ingestion of a carbonated drink before exposure of routine chest x-rays, (b) high KVP technique, and (c) alertness for variations in the density of the cardiac shadow.

**RESUMEN**

La hernia del hiatus, frecuentemente debida a relajamiento hiatal o a insuficiencia del hiatus, es relativamente común en los sujetos píncicos de más de 50 años. Se presentan tres casos ilustrativos, se leccionados entre 21 casos demostrados de hernia del hiatus, descubiertos en la investigación con película de 4 x 10, entre 4,200 enfermos de un hospital de enfermos mentales.

En una película sencilla de 4 x 5 o de 14 x 17, la presencia de hernia del hiatus, puede presumirse cuando se observa un nivel líquido supradiaphragmático, una burbuja de gas, o una opacidad redonda a través de la sombra del corazón o haciendo saliente en cualquiera de los ángulos cardiofrénicos. A veces la anomalía no puede sospechase por la película de ordinaria investigación; se examinan las razones para que esto ocurra.

Sugestiones para que se logre más a menudo el descubrimiento: en películas de 4 x 5 y 14 x 17 incluyen: (a) ingestión de una bebida bicarbonatada antes de tomar la película de rutina; (b) Alto kilovoltaje y estar alerta de los cambios de densidad de la imagen cardíaca.

**RESUME**

La hernie à travers le hiatus oesophagien, causée surtout par le replâche- ment ou l'insuffisance du hiatus, est relativement fréquente chez les sujets pykniques après 50 ans. Trois observations illustrées ont été choisies parmi 21 cas prouvés, découverts pendant l'examen systématique du thorax (radiographie sur films 4 x 10 inches) de 4200 malades dans un asile d'allénés.

On peut présumer l'existence d'une telle hernie lorsqu'on trouve sur le cliché standard (4 x 5 ou 14 x 17 in.) un niveau de liquide, une bulle gazeuse
ou une opacité arrondie, projetées au-dessus du diaphragmes et visibles à travers l'ombre du cœur, parfois même saillant dans un des angles cardio-phréniques. Quelquefois, le premier film ne permet pas de soupçonner une hernie; les raisons en sont discutées.

Pour augmenter le nombre des cas de hernie du hiatus découverts sur des radiographies $4 \times 5$ ou $14 \times 17$ in., l'auteur suggère (a) l'ingestion d'une boisson gazeuse avant la prise du cliché, (b) l'usage d'une technique à haut kilovoltage, et (c) être à l'alerte pour les variations de densité de l'ombre cardiaque.

**REFERENCES**

DETECTION OF HIATUS HERNIA