

C.O.O.

THE ROLE OF RADIOLOGY IN DIAGNOSIS OF

DIAPHRAGMATIC HERNIA

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INTRODUCTION AND AIM OF WORK

Diaphragmatic hernia is the protrusion of abdominal viscera into the thoracic cavity through a defect in the diaphragm. This may be due to congenital absence of a part, to enlargement of a naturally occurring opening, or to disruption of the continuity of the diaphragm incident to accidental trauma or surgery (Conn et al 19).

Diaphragmatic hernia has different modes of presentation. It presents as cyanosis and respiratory difficulty immediately after birth (Conn et al 19), or as repeated attacks of vomiting in the first week of baby's life (Shanks 1969). Later in adulthood, it may present as heart burn, angina-like pain both of which usually are related to posture and are reduced in severity by a potent alkali (Shanks 1969). It may also present as a cardio-respiratory or gastro-intestinal trouble immediately or later after thoraco-abdominal trauma.

Historically, the first description of diaphragmatic hernia in the modern literature was that of the post-traumatic variety and was given by Ambroise Paré in 1610 and this was two cases discovered at autopsy. Congenital hernia was first reported in 1698 by Riverius (Bockus 1963).

No case of hiatus hernia was clinically diagnosed before 1900 (Botha 1962).

The aim of this work is to know the role of radiology in the diagnosis of the different types of diaphragmatic hernia, the demonstration of the possible complications, in order to give the clinician the sufficient data to help him in planning the best line of treatment.

EMBRYOLOGY

In order to understand some points in congenital diaphragmatic hernia, a short resume of diaphragmatic development is given.

The diaphragm is developed in the embryo as a sheet of mesoderm dividing the primitive coelomic cavity into thoracic and abdominal cavities. This sheet, septum transversum, extends from the ventral and lateral regions of the body wall to the fore-gut. The pleuro-peritoneal canals, which are the postero-lateral channels communicating the pleural with the peritoneal cavity, are closed by fusion of the septum transversum with the pleuro-peritoneal membranes. The latter are dorsilateral to the canals (Davies 1972).

Normally, the closure of the pleuro-peritoneal canals occurs by the eighth week, and the return of the intestine from the yolk stalk to the abdominal cavity occurs during the tenth week of intra-uterine life, thus herniation through the pleuro-peritoneal canals may occur if the intestine returns prematurely before the eighth week or if there is delayed or incompleated closure of the pleuro-peritoneal canals (Fraster 1970).

A N A T O M Y

The diaphragm is a powerful muscle of respiration and consists of a thin fibromuscular sheet which separates the thoracic from the abdominal cavity. It is attached by muscle and tendinous fibers to the bony skeleton, the spine posteriorly, the ribs laterally and the sternum anteriorly. From this circumferential origin, the fibers sweep in a smooth curved ascent, convexity upwards to reach a central trefoil tendon (Sutton 1971).

Radiologically, in the P.A. view, the upper surface of the diaphragm is visualized because of contrast with the air-filled lung above. The under surface blends without radiographic distinction into the radio-opacity of the liver on the right side. On the left side it is indicated by the gases in the gastric fundus. The lateral costophrenic angles are usually acute and sharply defined. The cardiophrenic angles are usually less well defined and less acute, they are often right angular or obtuse depending on the contour of the adjacent cardiac border (Sutton 1971).

In the lateral view, the posterior costo-phrenic angle is sharply acute. From this posterior costal attachment the diaphragm rises often sharply, convexity upwards to reach

the mid-coronal plane, from which the cupola extends forwards along a line which is often almost horizontal or slightly descending anteriorly. The upper surface of the anterior half or third of the left dome is not seen radiographically because of the heart lying directly above it (Sutton 1971).

The openings in the diaphragm include three large single nearly median plane openings, two naturally closed foramina on each side and several minute apertures transmitting small vessels and nerves.

The three large single openings are three normal apertures in the diaphragm, through each of which pass a vital tubal structure. The first for the aorta, the second for the oesophagus and the third for the inferior vena cava (Fig. 1). The first and last one are very rarely involved in hernia, while the second is a very common site for herniation of the stomach into the chest (Lillington 1977).

The oesophageal hiatus is the middle of the three openings with a level at the tenth thoracic vertebra, and an antero-posterior position which is in between the other two. It is above, in front and a little to the left of the aortic opening. It transmits the vagus nerves and the oesophageal branches of the left gastric artery in addition

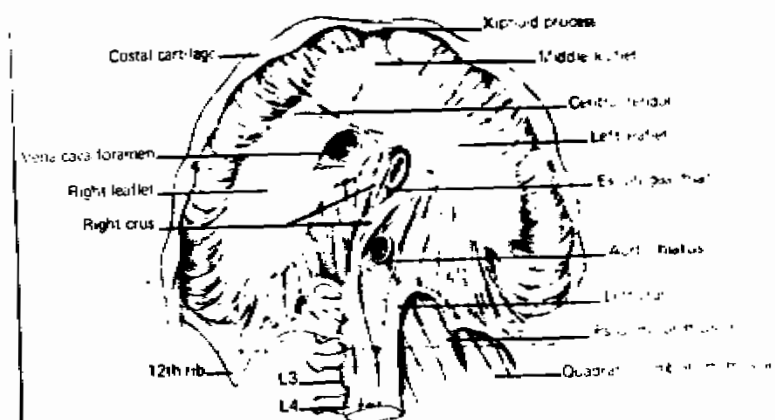


Figure 22-8. Inferior surface of diaphragm

Fig. 1

to the oesophagus (Davies 1972). The average diameter of the hiatus is between 1.8 and 2.5 cm. It is generally wider in older subjects, with no appreciable sex difference (Botha 1962). Radiologically, the hiatus cannot be visualized except during the flow of barium through it. It bears a variable relation to the top of the dome. It can be identified by the reduction in the width of the barium stream seen going through it during deep inspiration (Shanks 1969).

There is no direct continuity between the oesophageal wall and the muscle forming the oesophageal opening. The fascia on the under-surface of the diaphragm which is rich in elastic fibers, extends upwards into the opening in a conical fashion to be attached to the wall of the oesophagus about 2 cm. above the gastro-oesophageal junction. Some of its elastic fibers penetrate to the sub-mucosa of the oesophagus. This fascial expansion (Fig. 2) is termed phreno-oesophageal ligament or membrane (Davies 1972). It cannot be demonstrated radiologically (Maclean 1958), but its attachment to the oesophagus could produce a ring indenting the barium column at a barium swallow (Lodge 19).

The two naturally closed foramina are the Morgagni foramina antero-medially and the Bochdalek foramina postero-laterally (Fig. 3).

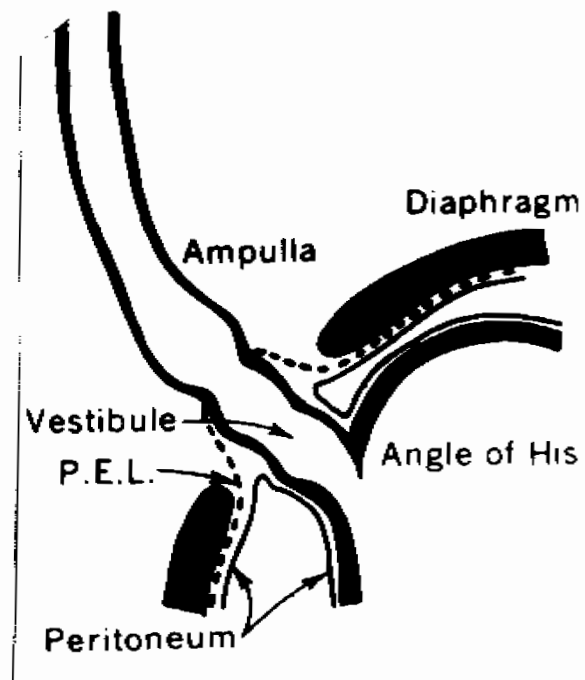


Fig. 2

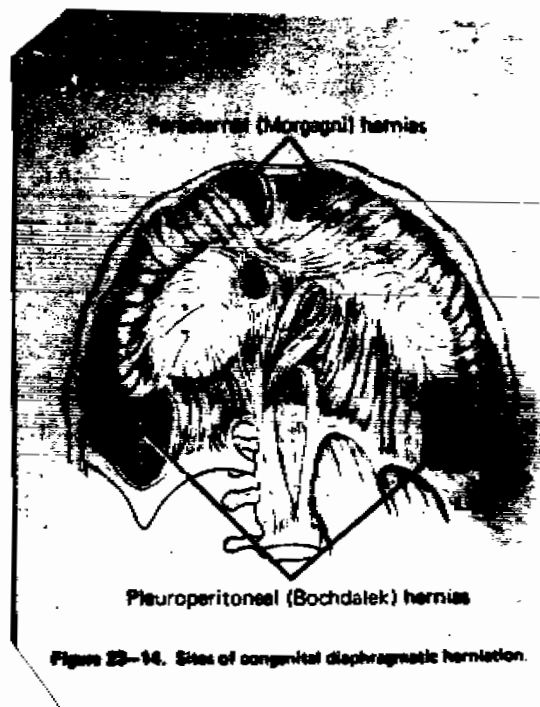


Fig. 3

The Morgagni foramina are small clefts one on each side of the lower border of the sternum. They are bounded by diaphragmatic muscle fibers originating from the sternum medially and from the seventh costal cartilage laterally. They are triangular, the base being formed by the anterior thoracic wall and the apex being directed posteriorly. The clefts contain the superior epigastric vessels and normally are filled with loose areolar connective tissue and fat (Fraster 1970).

The Bochdalek foramina are situated in the most posterior and most lateral parts of the diaphragm between its slips of origin from the lateral arcuate ligament posteriorly and those from the ribs laterally (Davies 1972). Normally there is no actual gap because of the close approximation of its edges.

The lower part of the oesophagus descends in the posterior mediastinum then pass through the oesophageal hiatus to join the stomach at its cardiac orifice. Its right border continues evenly into the lesser curvature of the stomach while its left border is separated from the fundus of the stomach by the cardiac notch, incisura or angle of His.

The sphincteric segment is the lowest 3 to 5 cm. of

the oesophagus. Anatomically and histologically, it is similar to the upper part but have a separate nerve supply (Chrispin and Friedland 1966). Physiologically, it can be identified by pressure recording devices which show it as a high pressure segment due to its normal resting state of mild tonic contraction. Radiologically, it is seen as a narrow contracted empty segment during barium examination. It starts to relax one sec. after the swallow is initiated, relaxation increases and then decreases, slowly recovering its normal resting tone by the time the peristaltic wave reaches the sphincter, then passing into a supercontracted state and appears as though it is the peristaltic wave running into the sphincter and squeezing out the last drop from the segment before regaining again its normal resting state of mild contraction (Shanks 1969).

P H Y S I O L O G Y

The diaphragm is the principal muscle of quiet respiration. It is the septum which separates the low pressure thoracic cavity with its contents from the high pressure abdominal one with its viscera. It plays a role in the circulation of blood. It is an important muscle in the act of straining. It assists in the antigastro-oesophageal reflux mechanism by three actions. The first is the closing action, due to the overlapping of the crural fibers forming the oesophageal hiatus providing a relatively long oblique, snug-fitting hiatus that ensures maximum fixation. When the diaphragm contracts, the diameter of the hiatus will decrease from side to side as well as from front to back (Botha 1962). The second action is a holding one and this is done by the phreno-oesophageal ligament which prevents slipping of the cardia chestwards through the hiatus during diaphragmatic descent in inspiration. The pinch-cock action is the action in which the angle of the cardia is maintained by the longitudinal bands of the right crus of the diaphragm during its descent in inspiration and preventing reflux particularly during sudden strain (Shanks 1969).

The oesophagus is the tunnel through which food, fluid,