DIAPHRAGMATIC HERNIA

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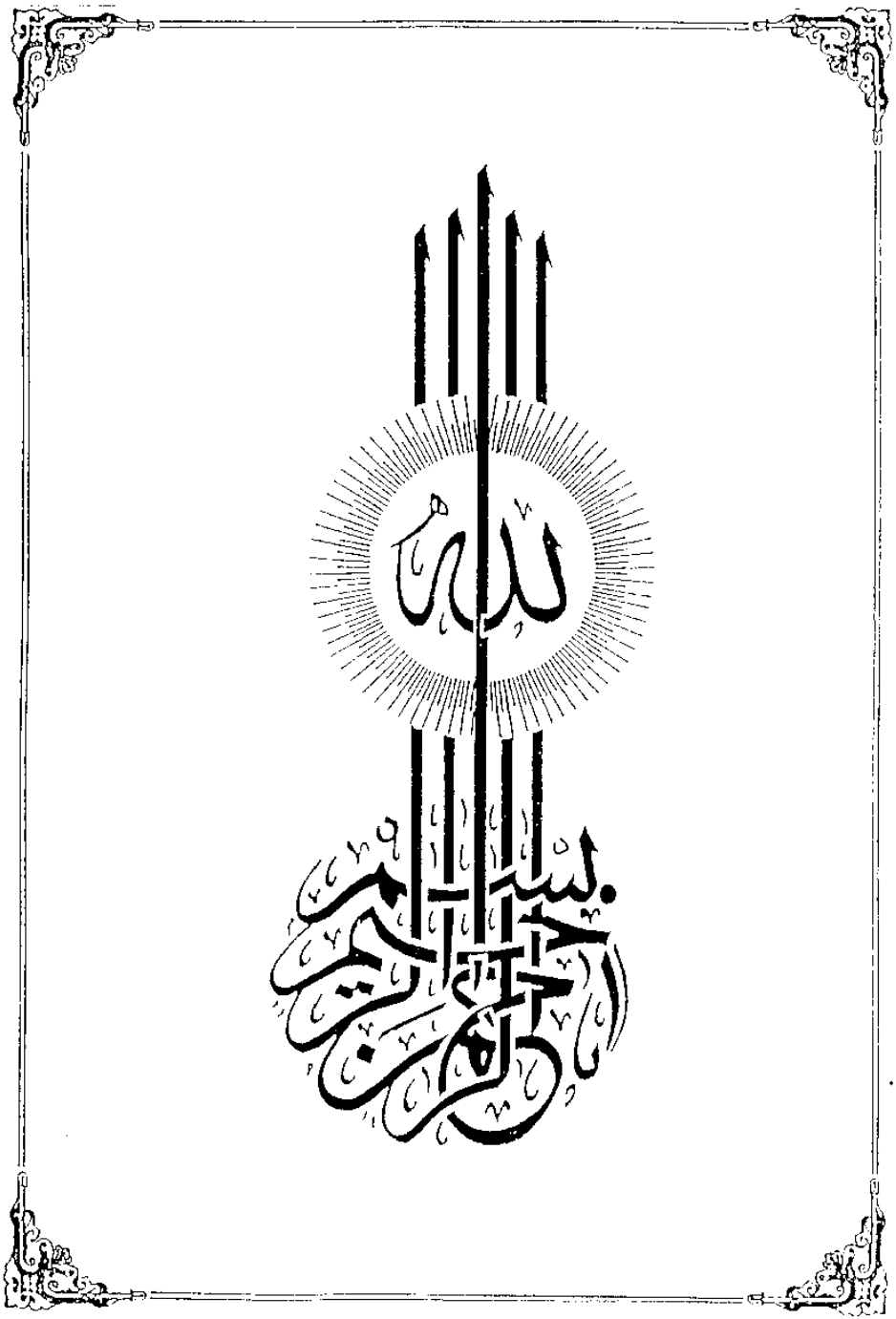

CONTENTS

INTRODUCTION

Diaphragmatic hernia is an abnormal protrusion of an abdominal organ or a part of it through an aperture in the diaphragm, whether this aperture is a congenital defect, natural opening or traumatic rupture *(McFarlane and Thomas, 1979)*.

Diaphragmatic hernia may be congenital or acquired.

CONGENITAL DIAPHRAGMATIC HERNIA:

The most common type is Bochdalek hernia. the embryological pleuroperitoneal canal represented by the Foramen of Bochdalek is the site through which the hernia occurs, lying posteriorly in the diaphragm. Most of Bochdalek hernias do not have a peritoneal sac and eighty percent occur on the left side *(Ellis, 1986)*.

The Foramen of Morgagni, situated anteriorly between the xiphoid and costal origin of the diaphragm, is the site of a rare congenital diaphragmatic hernia (Ellis, 1986).

Another rare type is the congenital para-oesophageal hernia. A part of the stomach enters the posterior mediastinum through congenital widening of the oesophageal

hiatus with no incompetence at the cardia and the oesophagogastric junction remains at the normal level below the diaphragm *(McFarlane and Thomas, 1979)*.

Failure of development of part of the septum transversum lead to hernia of the dome due to absence of one half of the diaphragm and pleural and peritoneal cavities are freely communicated on the left side, while the right side is usually protected by the liver *(McFarlane and Thomas, 1979)*.

Congenital eventration of the diaphragm gives similar symptoms as diaphragmatic hernia with a sac. In eventration of the diaphragm, its muscle is thin and non-functioning and has a normal anatomical distribution.

McFarlane and Thomas (1979) considered congenital short oesophagus to be a type of congenital diaphragmatic hernia. In this type, most of cases are due to the sliding of the cardia and portion of the fundus of the stomach into the mediastinum with no hernial sac.

ACQUIRED DIAPHRAGMATIC HERNIA:

The commonest situation is the sliding hernia (75% of cases), and it occurs when the cardia slides through the oesophageal hiatus into the mediastinum. Less commonly (20%

of cases) is the rolling or para-oesophageal hernia, where the gastro-oesophageal junction remains in its correct anatomical position with the gastric fundus rolling along its side through the oesophageal hiatus into the mediastinum. In 5% of cases, the two conditions co-exist together (mixed hernia) *(Ellis, 1986)*.

Traumatic diaphragmatic hernia may follow penetrating or crush injuries, but also in several cases is probably due to sudden increased in intra-abdominal pressure resulting in a pressure gradient across the diaphragm, like heavy physical effort, sudden twisting movements, child birth and cough fits. Because of the protective effect of the liver, it is nearly always the left hemidiaphragm which is implicated. A tear in the diaphragm may remain undetected for years and then may be complicated by herniation of abdominal contents mostly in the left hemithorax with subsequent strangulation of the stomach, greater omentum and colon which are most particularly at risk *(Ellis, 1986)*.

Disruption of the diaphragm may occur as a consequence of some acute inflammatory process such as subphrenic abscess or empyema *(Peter et al., 1989)*.

Acquired eventration of the diaphragm is probably due to phrenic nerve paralysis or dysfunction through a birth injury.

EMBRYOLOGY OF THE DIAPHRAGM

Formation of the diaphragm takes place between the fourth and the eighth weeks of embryonic life.

The diaphragm, heart and pericardium are formed in the neck and obtain their innervation from C3,4,5,. They migrate to their ultimate destinations carrying their nerve supply with them *(Decker and Plessis, 1986)*.

The intraembryonic ceolom starts to divide during the fourth week of gestation to form the different body cavities, pericardial. pleural and peritoneal cavities, through the development of a mesodermal partition to occupy the position of the future diaphragm in adult *(Warwick and Williams, 1975)*.

The diaphragm is derived from the following structures:

The dorsal mesentery:

The median portion of the diaphragm is formed from the dorsal mesentery of the oesophagus. The crura of the diaphragm develop from muscle fibres which grow into the dorsal mesentery of the oesophagus; they form an arch which overlies the aorta. The crura are sometimes referred to as the aortic component of the diaphragm *(Decker and Plessis. 1986)*.

The body wall:

The lateral body wall is burrowed by the enlarging lungs and pleural cavities and is split into two layers: an outer layer which will form part of the definitive body wall, and an inner layer that contributes to the peripheral portion of the diaphragm *(Decker and Plessis, 1986)*.

The septum transversum:

The septum transversum is formed in the neck region by the fusion of the myotomes of the third, fourth and fifth cervical segments, and it pulls its motor nerve supply with it, while pushed caudally by the descending heart from neck to thorax. It is a mass of mesoderm that lies between the pericardial cavity and the vitelline duct.

It is an incomplete septum, since the pleuro-peritoneal canals lie postro-laterally on each side. Following the descent of the septum, with the heart into the thorax, it comes to project horizontally posteriorly from the anterior or central body wall to meet the dorsal mesentery. The septum transversum now becomes separated into 3 layers:

a) Superior layer which helps to form the fibrous pericardium.

b) Middle layer which forms all the muscle of the diaphragm, the central tendon and the central areas of the pleura and peritoneum covering the diaphragm.

c) Inferior layer, which forms the fibrous capsule and connective tissue of the liver and central mesentery of the developing gut *(Snell, 1975)*.

In the centre of the diaphragm, the central tendon remains fused with fibrous pericardium, while in the periphery they are separated by the enlarged pleural cavities.

The fibrous capsule of the liver is separated from the diaphragm by the enlarged peritoneal cavity except in areas of mesenchyme, which become the falciform ligament, the right and left triangular ligaments and the coronary ligament *(Snell, 1975)*.

The Pleuroperitoneal membrane:

This membrane fuses with the septum transversum anterior to the oesophagus and the dorsal mesentery posterior to the oesophagus by growing medially from the body wall and encroaching on the pleuroperitoneal canal. During fusion, the mesoderm of the septum trnasversum extends to the other

parts, thus forming the entire muscle of the diaphragm *(Snell. 1975)*.

Different types of congenital diaphragmatic hernias occur due to failure of fusion of various elements that form the diaphragm:

1) Hernia through the pleuroperitoneal canal (Bochdalek hernia): Most cases occur without hernial sac, as the canal remains opened and there is a free communication between the pleural and abdominal cavity. Few cases occur with a hernial sac when the canal is closed by a layer of peritoneum and pleura *(Snell, 1975)*.

2) Hernia through the space between the sternal and costal origin of the muscle of the diaphragm (Morgagni hernia): These spaces allow a small hernial sac of peritoneum and pleura to protrude into the thorax and may contain loops of small intestine when there is a part of the muscle of the diaphragm that fails to develop from the septum transversum *(Snell. 1975)*.

3) Congenital para-oesophageal or rolling hernia: The anterior wall of the stomach rolls upwards in a hernial sac through a defect anterior and to the right of the oesophagus, until it may be upside down in the posterior mediastinum. An important criteria of this hernia is that

the normal relationship of the cardio-oesophageal junction to the diaphragm is undisturbed.

There are two theories about the origin of this hernia: One theory proposes that the posterior mediastinum contains a peritoneal process and the developing stomach invaginates the peritoneum from behind. Another theory proposes that there is a widening in the oesophageal hiatus allowing the stomach to herniate into a sac to the right of the oesophagus due to a congenital defect in the right crus of the diaphragm. This type of hernia is rare and the only way it can disturb the mechanics of the oesophagus is by its bulk compressing the oesophagus against the vertebral column *(Decker and Plessis, 1986).*

4) Eventration of the diaphragm: The diaphragm in these cases is formed from a fibrous sheet covered superiorly by pleura and inferiorly by peritoneum due to a defect in the developing muscle of the diaphragm which is immobile and pushed into the thorax at a level higher than normal *(Snell, 1975).*

ANATOMY OF THE DIAPHRAGM

The diaphragm is a dome-shaped musculomembranous structure separating the thoracic and abdominal cavities. Its peripheral portion consists of muscle fibres which originate from the sternal, costal and vertebral margins of the thoracic outlet, and converge to an insertion in a central tendon *(McVay, 1984)*.

Form of the diaphragm:

Viewed from above, the outline is kidney shaped, in conformity with the oval outline of the body wall which is indented posteriorly by the vertebral column *(Last, 1990)*.

Viewed from in front, the diaphragm curves up into right and left domes, The right is higher than the left ascending in full expiration as high as the fourth intercostal space, while the left dome reaches the fifth rib. The central tendon is levelled with the lower end of the sternum (sixth costal cartilage). Viewed from the side, the profile of the diaphragm resembles an inverted J, the long limb extending up form the crura (Upper lumbar vertebrae) and the short limb attached to the xiphisternum (the eighth vertebra) *(Last, 1990)*.

Attachments:

The muscle fibres arise from the margins of the inferior aperture of the thorax and pass superomedially to the edge of the flat C-shaped central tendon. The anterior fibres are nearly horizontal, but the posterior fibres pass almost vertically upwards and leave a deep recess between the thoracic wall and the diaphragm (costo-diaphragmatic recesses) and lower part of the posterior mediastinum *(Romanes, 1972)*.

The origin of the diaphragm may be divided into three parts:

1. The sternal origin: consists of two small slips from the back of the xiphoid process.

2. the costal origin: is by wide, obliquely placed slips from the lower six costal cartilages, with slips of transversus abdominis fitted between them

3. The vertebral origin is by the crura and the arcuate ligaments *(Snell, 1981)*.

CRURA:

These are thick fleshy bundles that taper inferiorly to be attached to the anterior surface of the upper two (left) or three (right) lumbar vertebral bodies, and the intervening discs by tendinous slips, which arch over the lumbar vessels on vertebral bodies. The muscle fibres of the right crus deviate to the left as they pass towards the central tendon and thus surround the oesophageal hiatus *(Romanes, 1972)*.

ARCUATE LIGAMENTS:

Superiorly, the medial sides of the two crura are united by a tendinous band (the median arcuate ligament) over the anterior surface of the aorta, at the level of the twelfth thoracic vertebra. Laterally, the tendinous part of each crus is connected to the transverse process of the first (or second) lumbar vertebra by a tendinous thickening of the fascia over psoas major, the medial arcuate ligament. The lateral arcuate ligament, a linear thickening of the anterior layer of the thoraco-lumbar fascia over quadratus lumborum, passes from the medial arcuate ligament over the anterior surface of quadratus lumborum to the twelfth rib. All three ligaments give rise to muscle fibres of the diaphragm, though they are relatively few from the lateral