

Recent Updates in the Management of Diaphragmatic Hernia

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آخر التحديثات في علاج فتق الحجاب الحاجز

خطة بحثية للحصول على درجة الماجستير في جراحة القلب والصدر

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INTRODUCTION

The diaphragm is a dome-shaped, musculoaponeurotic structure separating the thoracic and peritoneal cavities. This constantly active striated muscle increases the volume of the thoracic cavity with contraction and reduces thoracic volume on relaxation. ^(١)

Diaphragmatic hernia is the main surgical condition of the diaphragm. This condition can be classified into congenital (Bochdalack, Morgagni and eventration of diaphragm), traumatic and hiatus hernia (Sliding, paraesophageal). ^(١)

The incidence of congenital diaphragmatic hernia (CDH) has been reported as ١ in ٣٠٠٠–٥٠٠٠ live births, however, in population studies – including cases resulting in premature terminations, still births and neonatal deaths prior to transfer to tertiary centers – the incidence approaches ١ in ٢٠٠٠. ^(١)

Infants with congenital diaphragmatic hernia may be quite ill at birth, often suffering from acute respiratory distress and hemodynamic instability. ^(١)

The prognosis of congenital diaphragmatic hernia has improved dramatically in the last decade, and for those infants diagnosed in utero, the survival rate is now as high as ٨٠% with antenatal diagnosis and optimal care. ^(١)

Today, traumatic diaphragmatic hernia has become a lesion of increasing incidence and importance. The early detection of diaphragmatic injury is very important as this will prevent its harmful effects as respiratory distress, herniation of abdominal viscera and also its delayed effects which include the technical problems of repair due to atrophy of remnants of diaphragm and possibility of strangulation. ^(٤٦)

Injury to (or rupture of) the diaphragm as a result of blunt truncal trauma is seen with increasing frequency. The prevalence of diaphragmatic rupture among blunt trauma victims ranges from ٠,٨% to ٨%. ^(٢٥)

Diaphragmatic injuries can be classified according to the mechanism of injury, side involved, unilateral or bilateral location, clinical sequelae after the onset of injury, and severity of the anatomical disruption. Because the diaphragm is buffered by the liver on the right side, ٩٥% of injuries occur on the left side, bilateral injuries occur in less than ٣% of all cases. ^(٢٥)

Unfortunately, the clinical diagnosis of rupture of the diaphragm is difficult and is missed in ٧% to ٦٦% of patients. Physical findings were nonspecific, consisting primarily of chest and abdominal-wall contusions seen only in ١٦% of patients and respiratory distress seen in ٥٢% of ٦٠ patients. ^(٢٧)

The classical symptoms of hiatal hernia are heartburn, regurgitation, odynophagia (painful swallowing), globus and occasionally waterbrush. ^(۳۷)

Any operation or incision involving the diaphragm requires a thorough knowledge of its anatomy. The diaphragm consists of a peripheral muscular zone that inserts into a central aponeurotic tendon. The peripheral portion of the diaphragm originates circumferentially from four points: sternum, ribs, anterior muscular, and posterior muscular. ^(۷)

Consequently, early detection, proper preparation and appropriate management are essential to achieve a good outcome. ^(۳۴)

Laparoscopic technique has been found to be associated with low morbidity and mortality rates, short hospital stay, decreased postoperative pain, and early return to full activity. ^(۳۴)

AIM OF THE WORK

The aim of this work is to provide a research about diaphragmatic hernia, updates in management and diagnosis, including different methods for diagnosis, different surgical approaches, endoscopic interference and recent trials in surgery to make an updated essay.

Embryology & Surgical Anatomy

Development of the Diaphragm:

The diaphragm is a composite structure that develops from four embryonic components (Fig. 1).

- Septum transversum.
- Pleuroperitoneal membranes.
- Dorsal mesentry of esophagus.
- Lateral body walls.

The diaphragm is a dome-shaped, muscletendinous partition that separates the thoracic and abdominal cavities. (1)

The Septum transversum :

The transverse septum composed of mesodermal tissue, is the primordium of the central tendon of the diaphragm (Fig. 1 D and E).

The septum transversum grows dorsally from the ventro lateral body wall and forms a semicircular shelf, which separates the heart from the liver (Fig. 2). During its early development, a large part of the liver is embedded in the septum transversum. The septum transversum is located caudal to the pericardial cavity and partially separates it from the developing

peritoneal cavity. The septum transversum is first identifiable at the end of the third week as a mass of mesodermal tissue cranial to the pericardial cavity. After the head folds ventrally during the fourth week, the septum transversum forms a thick incomplete partition between the pericardial and abdominal cavities (Fig. 3). The septum transversum does not separate the thoracic and abdominal cavities completely. A large opening, the pericardio peritoneal canal is found on each side of the esophagus (Fig. 1B). The septum transversum expands and fuses with the mesenchyme ventral to the esophagus (primitive mediastinum) and the pleuroperitoneal membranes (Fig. 1C).⁽¹⁾

The pleuroperitoneal Membranes:

These membranes fuse with the dorsal mesentery of the esophagus and septum transversum (Fig. 1C). This completes the partition between the thoracic and abdominal cavities and forms the primordial diaphragm. Although the pleuroperitoneal membranes form large portions of the fetal diaphragm, they represent relatively small portions of the newborn infant's diaphragm (Fig. 1E).⁽¹⁾

The dorsal Mesentery of the esophagus :

As previously described, the septum transversum and pleuroperitoneal membranes fuse with the dorsal mesentery of the esophagus. This mesentery constitutes the median portion of the diaphragm. The crura of the diaphragm - a leg like pair of diverging muscle bundles that cross in the median plane anterior to the aorta (Fig IE) develop from myoblasts that grow into the dorsal mesentery of the esophagus. (v)

The muscular in growth from the lateral body wall:

During the 4th to 12th weeks, the lungs and pleural cavities enlarge "burrowig" into the lateral body walls (Fig. 4). During this excavation process, the body-wall tissue is split into two layers:

- An external layer that becomes part of the definitive abdominal wall.
- An internal layer that contributes muscle to peripheral portions of the diaphragm, external to the parts derived from the pleuroperitoneal membranes (Fig. ID and E).

Further extension of the developing pleural cavities into the lateral body walls form the right and left costodiaphragmatic recesses (Fig. 5), establishing the characteristic dome-shaped configuration of the diaphragm. After birth the costodiaphragmatic recesses become alternately

smaller and larger as the lung move in and out of them during inspiration and expiration. ^(١)

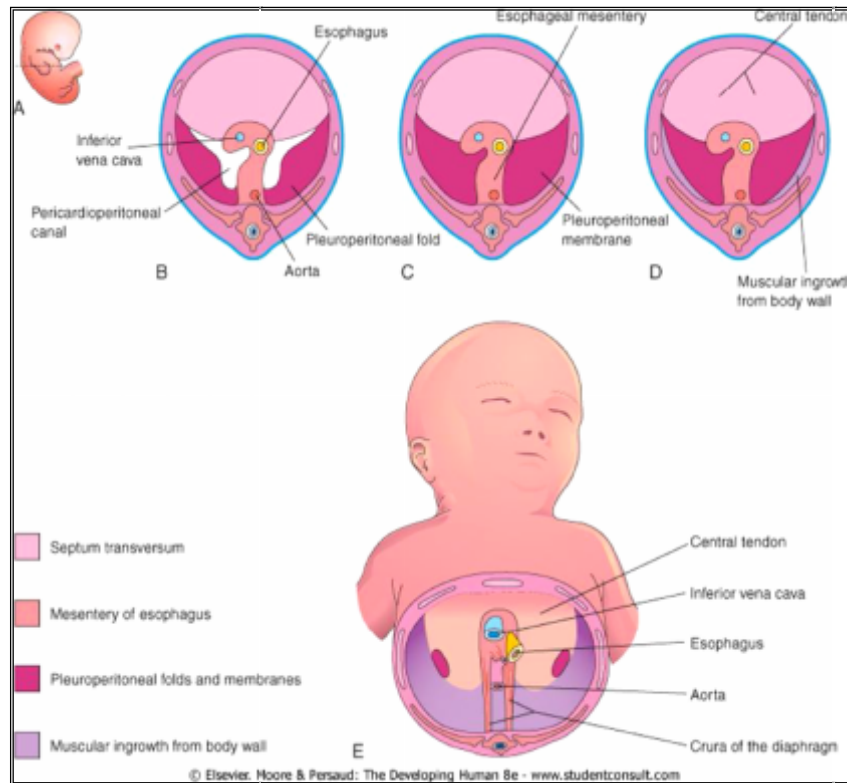


Figure (١) : Illustrations of development of the diaphragm. A, Sketch of a lateral view of an embryo at the end of the fifth week (actual size) indicating the level of sections in B to D. B to E, The developing diaphragm as viewed inferiorly. B, Transverse section showing the infused pleuroperitoneal membranes. C, Similar section at the end of the sixth week after fusion of the pleuroperitoneal membranes with the other two diaphragmatic components. D, Transverse section of a ١٢-week fetus after ingrowth of the fourth diaphragmatic component from the body wall. E, Inferior view of the diaphragm of a newborn indicating the embryologic origin of its components. ^(١)

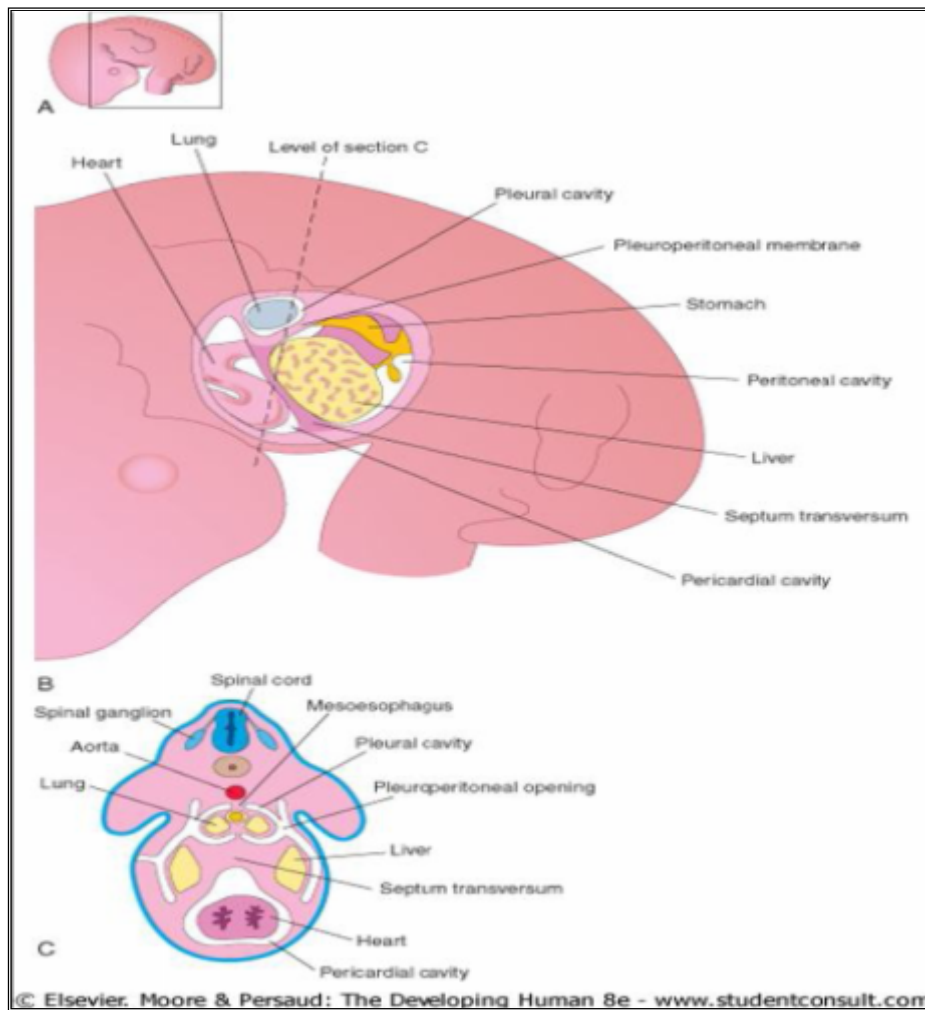


Figure 1: (A) Sketch of a lateral view of an embryo (approximately 33 days). The rectangle indicates the area enlarged in (B) The primordial body cavities are viewed from the left side after removal of the lateral body wall. (C) Transverse section through the embryo at the level shown in B.⁽¹⁾

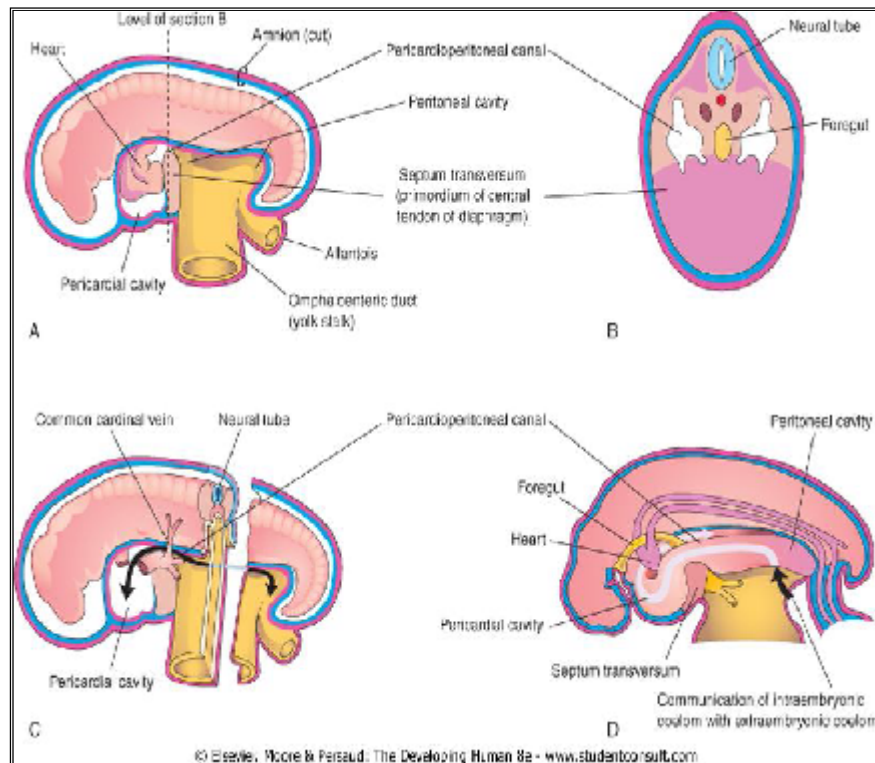


Figure 7: Schematic drawings of an embryo (approximately 14 days). **(A)** The lateral wall of the pericardial cavity has been removed to show the primordial heart. **(B)** Transverse section of the embryo illustrates the relationship of the pericardioperitoneal canals to the septum transversum (primordium of central tendon of diaphragm) and the foregut. **(C)** Lateral view of the embryo with the heart removed. The embryo has also been sectioned transversely to show the continuity of the intraembryonic and extraembryonic coeloms (arrow). **(D)** Sketch showing the pericardioperitoneal canals arising from the dorsal wall of the pericardial cavity and passing on each side of the foregut to join the peritoneal cavity. The arrow shows the communication of the extraembryonic coelom with the intraembryonic coelom and the continuity of the intraembryonic coelom at this stage.⁽¹⁾

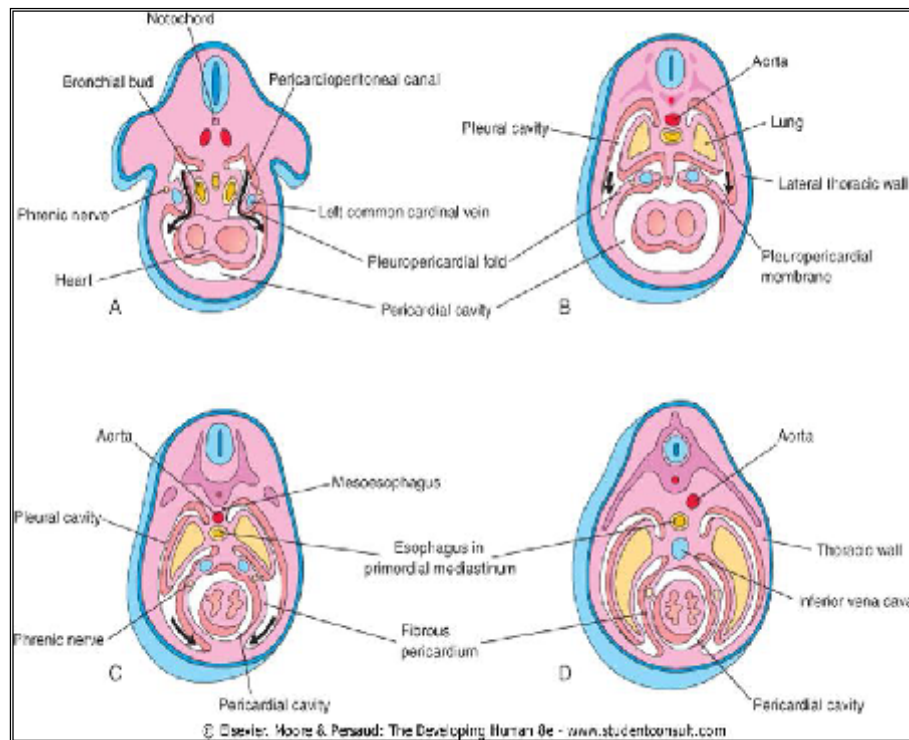


Figure 7 : Schematic drawings of transverse sections through embryos cranial to the septum transversum, illustrating successive stages in the separation of the pleural cavities from the pericardial cavity. Growth and formation of the fibrous pericardium are also shown. **(A)** At 4 weeks. The *arrows* indicate the communications between the pericardioperitoneal canals and the pericardial cavity. **(B)** At 5 weeks. The *arrows* indicate development of the pleural cavities as they expand into the body wall. **(C)** At 6 weeks. Expansion of the pleural cavities ventrally around the heart is shown. The pleuropericardial membranes are now fused in the median plane with each other and with the mesoderm ventral to the esophagus. **(D)** At 7 weeks. Continued expansion of the lungs and pleural cavities and formation of the fibrous pericardium and thoracic wall are illustrated. ⁽¹⁾

Positional changes and innervation of the diaphragm:

During the fourth week of development, the septum transversum, prior to its descent with the heart, lies opposite the third to fifth cervical somites (Fig. 1A). During the fifth week, myoblasts (primitive muscle cells) from these somites migrate into the developing diaphragm, bringing their nerve fibres with them. Consequently, the phrenic nerves that supply motor innervation to the diaphragm arise from the ventral rami of the third, fourth and fifth cervical spinal nerves. The septum transversum extends into the other three parts. It forms fourth and fifth cervical spinal nerves. The three twinges on each side join together to form a phrenic nerve. The phrenic nerve also supplies sensory fibers to the superior and inferior surfaces of the right and left domes of the Diaphragm.

Rapid growth of the dorsal part of the embryo's body results in the apparent descent of the diaphragm. By the sixth week, the developing diaphragm is at the level of the thoracic somites (Fig. 1 B). The phrenic nerve now have a descending course. As the diaphragm "moves" relatively further caudally in the body, the nerves are correspondingly lengthened.

By the beginning of the eighth week, the dorsal part of the diaphragm lies at the level of the first lumbar vertebra (Fig. 1 C). Because of the embryonic origin of the phrenic nerves, they are about 30 cm long in adults. The embryonic phrenic nerves enter the diaphragm by passing through the

pleuropericardial membranes. This explains why the phrenic nerves subsequently lie on the fibrous pericardium, the adult derivative of the pleuropericardial membranes (Fig. 1 C and D).

As the four parts of the diaphragm fuse (Fig. 1), mesenchyme in myoblasts that differentiate into the skeletal muscle of the diaphragm; hence the motor nerve supply to the diaphragm is from the phrenic nerves.

The sensory innervation of the diaphragm is also from the phrenic nerves, but its costal rim receives sensory fibres from the lower intercostal nerves because of the origin of the peripheral part of the diaphragm from the lateral body walls. (Fig. 1D and E).⁽¹⁾

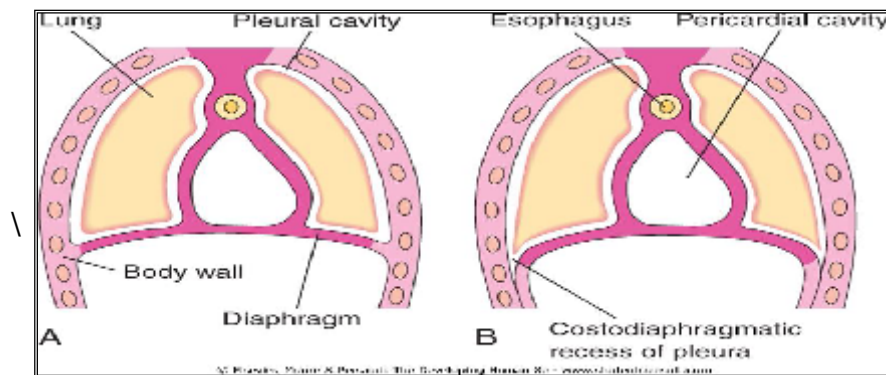


Figure 1 : Illustrations of extension of the pleural cavities into the body walls to form peripheral parts of the diaphragm, the costodiaphragmatic recesses, and the establishment of the characteristic dome-shaped configuration of the diaphragm. Note that body wall tissue is added peripherally to the diaphragm as the lungs and pleural cavities enlarge.⁽¹⁾