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Dual-layer sandwich mesh repair in the treatment of major diaphragmatic eventration in an adult

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Total eventration of a hemidiaphragm is a rare anomaly in adults. This condition could be subsequent to primary or acquired phrenic nerve palsy, but often it presents as a pure degenerative muscular disease without evident signs of denervation. Surgical repair is indicated only in cases of progressive exertional dyspnea, recurrent respiratory infections, or both. Routine surgical techniques counted are plication or incision, followed by double-breast suturing performed through a low posterolateral thoracotomy or minimally invasive access. We report a case of left major eventration in a 58-year-old woman in which the vanishing of most of the diaphragmatic tissue represented an extreme condition incompatible with the performance of a standard procedure.

Clinical Summary

A 58-year-old, female heavy smoker was admitted to our department for a 6-month history of progressive exertional dyspnea and left-sided chest pain. Ten years previously, the patient had a blunt chest trauma caused by a road accident without particular complications and with complete recovery after 5 days of hospitalization. Clinical examination revealed auscultatory bruising over the lower anterolateral quadrants of the left hemithorax; other clinical signs were absent, and laboratory parameters were within normal ranges. A standard radiograph of the chest showed a high displacement of the left hemidiaphragm with contralateral mediastinal shift. A computed tomographic scan of the chest showed a major eventration of the left hemidiaphragm with compressive atelectasis of the anterior segment of the lower lobe and appearance of some bilateral apical subpleural bullae. Completion computed tomographic scanning of the brain, neck, mediastinum, and whole abdomen yielded negative findings and did not show any central or peripheral nervous lesions accounting for a phrenic nerve palsy. Static and dynamic ventilatory function parameters demonstrated a mild restrictive pattern: forced expiratory volume in 1 second of 1.63 (54%), forced vital capacity of 1.85 (44%), total lung capacity of 3.08 (56%), expiratory reserve volume of 0.42 (46%), and functional residual capacity of 1.37 (47%). Ventilatory scintigraphy did not reveal ventilated parenchyma in the basal segments in the lower lobe of the left lung; the right lung was totally ventilated. Bronchoscopic results were negative, and cardiac function was proved to be normal. Five days later, the patient underwent a left posterolateral thoracotomy at the seventh intercostal space with selective thracheobronchial intubation. The stomach was drained with a nasogastric tube. The intraoperative finding was a large eventration of the whole left hemidiaphragm invading about 2 thirds of the pleural cavity. The central part of the phrenic dome was reduced to a thin transparent film constituted only by pleura and peritoneum through the left colic angle, and the great omentum was visible. At first, the apex of the phrenic dome was opened through a transversal incision,

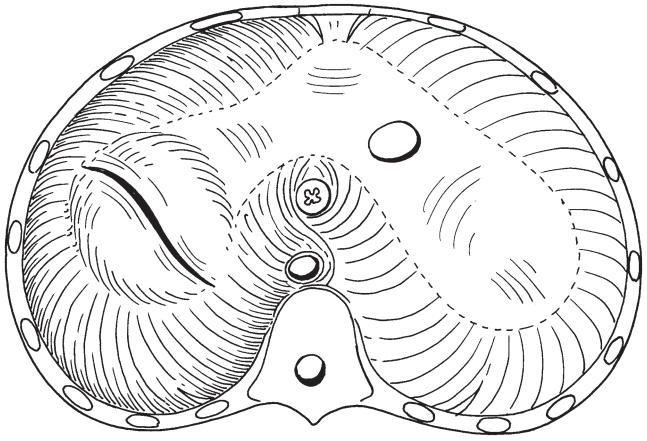

Figure 1. The apex of the phrenic dome opened through a transversal incision.

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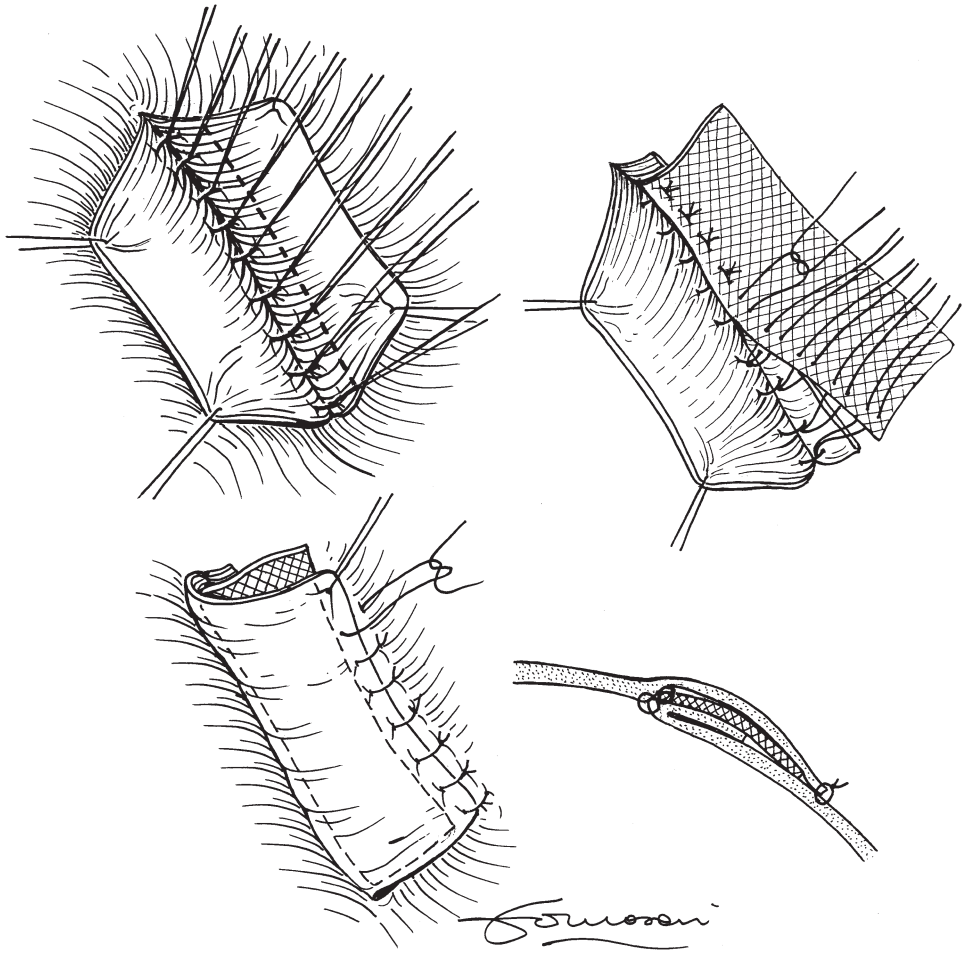

Figure 2. The suture line of single stitches performed between the 2 thicker and fleshy borders of the muscle. This resulted in two residual flaps of muscle, and the posterior thinner flap was excised. A dual mesh was tailored to fit the shape of the anterior flap and fixed with single stitches on the first suture line as reinforcement. The anterior flap was turned over and fixed around the borders of the diaphragm.

and the left colon, with the great omentum, was pushed down into the abdomen. A first suture line of single stitches was performed between the 2 thicker and fleshy borders of the muscle. This resulted in 2 residual flaps of muscle, and the posterior thinner flap was excised. A dual mesh was tailored to fit the shape of the anterior flap and fixed with single stitches on the first suture line as reinforcement. The anterior flap was turned over and fixed around the borders of the diaphragm, including the mesh as the stuffing of the "sandwich," restoring the integrity and strength of the apex of the dome (Figures 1 and 2). At the end of the procedure, a 28F chest tube was inserted. The postoperative course was uneventful, and the patient was discharged on the seventh postoperative day. She is doing well 24 months after the operation, with complete functional recovery.

Discussion

Total diaphragmatic eventration is an uncommon condition. Generally, the disease is a true congenital defect acquired during the fetal period associated with hypoplasia of the lung on the involved side, with appearance of severe cardiorespiratory symptoms at birth.[1,2] Eventration that occurs in adults is thought to be caused by acquired complete or incomplete palsy of a diaphragmatic leaf, often after head and neck operations or cardiovascular procedures. Other causes reported are trauma, motoneuron diseases, and neoplastic infiltration. Commonly, this condition is free of symptoms, and therefore any treatment is required. Some cases are associated with exertional dyspnea, respiratory failure, and/or recurrent pulmonary infections; however, their frequency is increased in heavy smokers and in patients with other primary or acquired respiratory diseases.[1,2] Right eventration with protrusion of the liver through the defect is often localized and asymptomatic and does not require any treatment. Surgical repair is reserved for patients with major left eventration with severe respiratory symptoms. Apart from access and technique, surgical correction is settled to remove lung compression and make the thoracic base and mediastinum more

steady, restoring a satisfactory ventilation.[3-5] In our case an extreme condition of vanishing of the muscular support of the hemidiaphragm forced us to perform an alternative technique with optimal functional results.

The aim of this technique was as follows: (1) tailoring a plastic correction with a prosthetic mesh with a greater pressure-proof guarantee compared with that seen in the traditional surgical techniques; (2) creating an area of thickness corresponding to a new durable central tendon able to resist the constant abdominal pressure exerted by the viscera; and (3) avoiding a direct contact between the prosthesis and the lung parenchyma.

Optimal functional results and complete anatomic integration led us to believe that this technique could be worthy of consideration in the treatment of major diaphragmatic eventration.

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An unusual case of lateral pulmonary hernia

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Pulmonary hernia is a rare occurrence and may be congenital or acquired, the latter usually being a consequence of thoracic trauma. We report an unusual case of large lateral pulmonary hernia through a chest wall defect in a 70-year-old man involved in a motorcycle accident.

Clinical Summary

A 70-year-old obese man was involved in a high-speed motorcycle accident. Initial evaluation at the scene revealed a Glasgow Coma score of 14, left shoulder luxation, cranial trauma with left hemophthalmos, and multiple rib fractures. His blood pressure was 110/65 mm Hg, and his heart rate was 105 heart beats/min. At admission to our hospital, the patient had severe chest pain and dyspnea. Physical examination revealed a large subcutaneous emphysema involving the chest, neck, and left superior arm. He was in severe respiratory acidosis. Radiography examination revealed a left humerus fracture, a left pneumothorax, multiple rib fractures, a large left-sided effusion, and a huge subcutaneous emphysema. A total-body computed tomography (CT) scan revealed a left orbital fracture, a left pneumothorax, multiple rib fractures, a left hemothorax, and a large lateral lung hernia protruding through a chest wall defect between the sixth and seventh ribs with contralateral pulmonary contusion (Figure 1).

The patient was rushed to the operating room. General anesthesia was carried out with double-lumen endotracheal intubation, and in right lateral decubitus the chest was entered between the sixth and seventh intercostal space. The serratus magnus and intercostal muscles were torn, the left lung was carefully freed from rib spicules, and the hemothorax was evacuated. When the left lung was reexpanded, the parenchyma went out through a large lateral chest defect. At this point the surgical incision was widened as a regular thoracotomy. A careful examination excluded bronchial, vascular, diaphragmatic, and pericardial injuries. Small pulmonary lacerations and rib fractures were repaired, the pleural cavity was irrigated, and 2 chest tubes were inserted. A double-sheet, large (12 × 6 cm) Prolene mesh was inserted on the inner side of the thoracic cage to completely close the chest defect. The serratus magnus muscle was repaired, and the chest was closed. The patient was transferred to the intensive care unit where he was extubated 3 hours later. The postoperative course was uneventful, and the chest tubes were removed after 6 days. The patient was discharged on the tenth postoperative day. Six months postoperatively, he was in good clinical condition. The CT scan revealed the complete healing of the pulmonary lesion (Figure 2).

Discussion

Lung hernia, protrusion of pulmonary parenchyma with pleural membranes through a defect of the thoracic wall, is a rare entity. The cause is acquired in approximately 80% of cases and of traumatic origin, and this may not become apparent for several weeks to years after the trauma. Sixty-five per cent of lung hernias have a thoracic location.[1] The thoracic cage has inherent weakness anteriorly, near the sternum, and posteriorly, near the vertebral bodies, where there is a single layer of intercostal muscle. The

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