Paper-thinned Diaphragm :
CT Sign of Diaphragmatic Eventration

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Abstract

CT findings of total left hemidiaphragmatic eventration in two adult patients are described. Chest radiograph showed elevated left hemidiaphragm and left hilum. Paper-thinned muscular portion of the diseased diaphragm was clearly demonstrated with CT scan. With demonstration of paper-thinned diaphragm by CT scan, differentiation of the diaphragmatic eventration from recent onset phrenic nerve paralysis by tumor invasion or from post-traumatic diaphragmatic hernia can be made.

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Introduction

Eventration of the diaphragm is generally defined as the abnormal elevation of all or a portion of one diaphragmatic leaf. It may be congenital, due to developmental malformation of diaphragmatic musculature, or acquired usually due to phrenic nerve paralysis. Either in congenital or acquired eventration, the muscular portion of the diaphragm is replaced by fibrous tissue resulting in thinning of the diaphragm.
In cases of hemidiaphragmatic elevation on chest radiograph, differentiation of eventration from recent onset phrenic nerve paralysis by tumor invasion or from post-traumatic diaphragmatic hernia is problematic.

We report two cases of total left hemidiaphragmatic eventration which showed paper-thinned muscular portion of the diaphragm on CT scan.

Report of Cases

Case 1

A forty six-year-old male presented with mild exertional dyspnea and discomfort on left subcostal area. There was no relevant past medical history that could cause left phrenic nerve injury. Pulmonary function test showed Forced Vital Capacity(FVC), 2.80 l(76.3%, predicted), Forced Expiratory Volume 1 second.(FEV1) 2.33 l(85.0%, predicted), Maximal Expiratory Flow Rate(MEF) 50%, 2.37 l(60.9%, predicted), indicating mild restrictive pattern. Chest radiograph showed elevation of the left hemidiaphragm and left hilum. There was no associated collapse of the left lower lobe(Fig. 1-a). CT scan showed paper-thin crural and costal portion of the left hemidiaphragm with remarkable elevation of the abdominal contents(Fig. 1-b, c).

![Fig. 1. Forty six-year-old male.](image-url)

a. Chest radiograph shows elevated left hemidiaphragm and left hilum.
b. CT scan at the level of dome of the liver shows infradiaphragmatic contents occupying the left lower hemithorax. Very thin left diaphragm is identified at crus and anterior subcostal area (arrows).
c. Note paper thinned left diaphragmatic crus(arrowheads), contrasted with normal right crus.
Case 2

A fifty-three-year-old female presented with dyspnea on exertion for 10 years which was aggravated since 3 years ago. Twenty years ago, she experienced post-prandial epigastric fullness and was treated with antituberculous chemotherapy under the impression of tuberculous pleurisy. Pulmonary function test showed FVC, 1.82 l(70.8%, predicted), FEV₁, 1.19 l(59.2%, predicted), MEF 50%, 0.70 l(19.1%, predicted) indicating mild restrictive and obstructive pattern.

Chest radiograph showed marked elevation of the entire left hemidiaphragm and the left hilum(Fig. 2-a, b). On routine thick section CT, left diaphragm could not be identified except faint linear density on left diaphragmatic crus area. High resolution CT showed paper-thinned left diaphragmatic crus(Fig. 2-c).

Discussion

Eventration of the total hemidiaphragm occurs due either to congenital anomaly or to acquired phrenic nerve injury. Congenital origin is presumably due to a developmental abnormality of diaphragmatic musculature. The muscle of the diaphragm is formed at 8th to 10th week of fetal life by ingrowth of muscle from the septum.
transversum and cervical myotomes between the pleuropperitoneal folds. Failure of proper muscularization at this period is believed to be a mechanism of congenital eventration. It is found more frequently in male, on the left, and is known to have intact anterior muscular rim\(^2\).\(^4\).

Eventration by acquired diaphragmatic paralysis can occur in variety of circumstances that incur injury to the phrenic nerve such as following mediastinal infection, inflammation, tumor and trauma. Though considerable effort has been expended to differentiate acquired from congenital origin, particularly in the adults, this is frequently an impossible differentiation. Differentiation of congenital eventration from acquired diaphragmatic paralysis is of no clinical significance except when the phrenic nerve paralysis is due to a progressive incurable disease, such as malignant tumor infiltration\(^2\).

Evaluation of the diaphragmatic thickness would be of great importance in differentiating congenital or early insult acquired diaphragmatic eventration from recent onset phrenic nerve palsy. To our experience, there was no identifiable thinning of the ipsilateral diaphragmatic muscle in cases of phrenic nerve palsy by malignant tumor infiltration. According to CT measurement of the diaphragmatic crus in normals by Caskey et al\(^6\), the thickness of the left crus was 71-83%, 68-88% of that of right in men and women respectively. In our cases, the thickness of the left diaphragmatic crus are less than 20% of that of the normal right crus.

Post-traumatic diaphragmatic hernia frequently manifests as elevated left diaphragmatic shadow several months or years after trauma.\(^7\) We believe that as the thickness of the diaphragmatic crura will not show significant thinning in cases of post-traumatic rupture, differentiation from total diaphragmatic eventration will easily be made by CT scan even though the disrupted diaphragm is not demonstrated.

**REFERENCES**