J Prima Med Sains (2024) 6(1):97-101
doi.org/10.34012/jpms.v6i1.5116

CASE REPORT

Diagnosis and imaging of diaphragmatic eventration: A case report

Ikhwanul Hakim Nasution[1,2*],Adi Soekardi[1,2], Redo Widhio Mahatvavirya[3]

Abstract

Background: Diaphragmatic eventration is a rare disorder that is typically found by accident in asymptomatic patients with a raised hemidiaphragm on chest X-rays. Both acquired and developmental defects can cause diaphragmatic eventration. The imaging methods for diaphragmatic eventration are numerous. Chest radiography should be done when there is clinical suspicion; this can be further confirmed with a chest computed tomography (CT). **Case presentation:** We present a case of a 37 years old woman with a left sided diaphragm eventration presenting as dyspnea and epigastrical discomfort. The diagnosis was made with chest x-ray and then confirmed with a chest CT scans. **Discussion:** There are several modalities to choose in diaphragmatic imaging. Chest x-ray is the main imaging method for diagnosing diaphragm eventration, in rare cases, a eventration needs to be differentiated using CT or MRI. Other imaging methods such as fluoroscopy and ultrasonography may be used in some instances to assess diaphragm function. **Conclusions:** There are various methods available in the field of diaphragmatic imaging. Certain methods, like CT and plain chest radiographs, concentrate on the anatomic anomalies of the diaphragm that may indicate dysfunction. Some instruments, including fluoroscopy and ultrasonography, are more appropriate for functional imaging.

Keywords: diaphragm eventration, diagnosis, imaging, case report

Introduction

The diaphragm is a dome-shaped muscle, or fibromuscular septum, made up of a greater circumferential muscular part that converges on the central tendon, and the noncontractile central fibrous section, or central tendon. The diaphragm is the main muscle involved in ventilation, which acts as a physical barrier between the positive pressure abdominal cavity and the negative pressure thoracic cavity. A benign or malignant disease rarely affects the diaphragm. However, respiratory function can be compromised by a variety of diaphragmatic diseases, including paralysis and diaphragmatic eventration.[1] A condition known as "eventration" occurs when there is localized diaphragm atrophy or when fibroelastic tissue replaces a portion of the diaphragm.[1,2] A developmental abnormality that replaces all or part of the diaphragm's muscular section with fibroelastic tissue that has proper attachments to the chest wall is the cause of true diaphragmatic eventration. Adults may also get eventration, most likely as a result of phrenic nerve damage.[2]

Diaphragm eventrations are more common in men, have a low incidence (0.05%), and tend to affect the left hemidiaphragm more frequently.[3] Abnormal diaphragmatic laxity and elevation are the symptoms of eventration.[2] Adult patients with diaphragmatic eventration typically have no symptoms at all; instead, they are diagnosed by chance with an inflated hemidiaphragm that is found during a chest roentgenogram. An objective assessment of dyspnea, a physical examination, pulmonary function tests, and imaging studies should all be part of the evaluation process for patients with diaphragmatic eventration who are symptomatic.[3,4] Radiography and CT scans can typically distinguish eventration from paralysis, albeit it can

Affiliation
[1]Department of Radiology, Universitas Prima Indonesia, Medan, Indonesia
[2]Royal Prima General Hospital, Medan, Indonesia
[3]Radiology Specialist Education Program, Universitas Prima Indonesia, Medan, Indonesia

Correspondence
ikwanulhakimnst@yahoo.com

occasionally be misinterpreted for a diaphragmatic hernia.[5] Numerous modalities are available in the field of diaphragmatic imaging. Certain studies, like CT and conventional chest radiographs, concentrate on the anatomic anomalies of the diaphragm that may indicate dysfunction. Some instruments, including fluoroscopy and ultrasonography, are more appropriate for functional imaging.[4] In this report, we present a diagnosis and imaging modalities of diapraghm eventration in adult.

Case Report

A 37 year old woman presented with upper abdominal pain, a sensation of pressure after meals and physical activites, and dyspnea. She had no significant medical conditions or family history concerns. Systemic examinations revealed normal respiratory rate and chest expansion. However, auscultation showed reduced vesicular breath sounds bilaterally.

On the initial plain chest radiograph (Figure 1), the right diaphragm appeared elevated, causing rightward displacement of the heart. An air shadow originating from the stomach and intestines was visible below the diaphragm, and there were No. parenchymal opacities observed. These findings suggested left diaphragmatic eventration. Contrast-enhanced thoracic computed tomography (CT) scans confiremd the diagnosis (Figure 2). The patient then underwent surgical intervention.

Post-operative plain radiograph (Figure 3) showed the right and left diaphragms in their normal positions, with minimal pleural effusion in the left lung, managed by chest tube insertion.

Discussions

Eventration occur when part of the normal diaphragm is replaced by a thin layer of connective tissue and a few muscle fibres (the unbroken continuity differentiates this from a hernia) and it also includes elevation as a result of acquired paralysis and associated muscular atrophy.[6] The underdevelop-

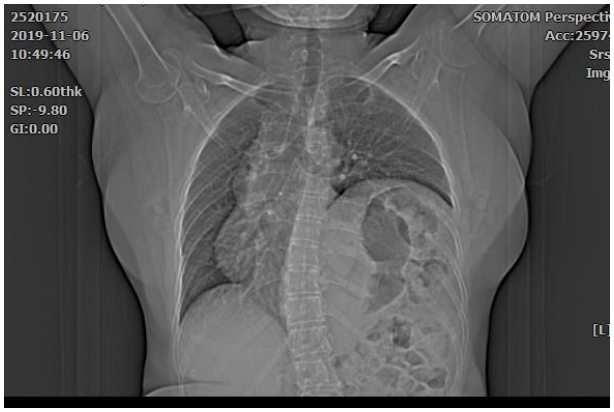

Figure 1. Preoperative plain chest radiograph showed an elevated left diaphragm with the heart appeared to be pushed to the right, followed by a gaseous image of stomach and sub-diaphragmatic bowel, suggesting left diaphragm eventration

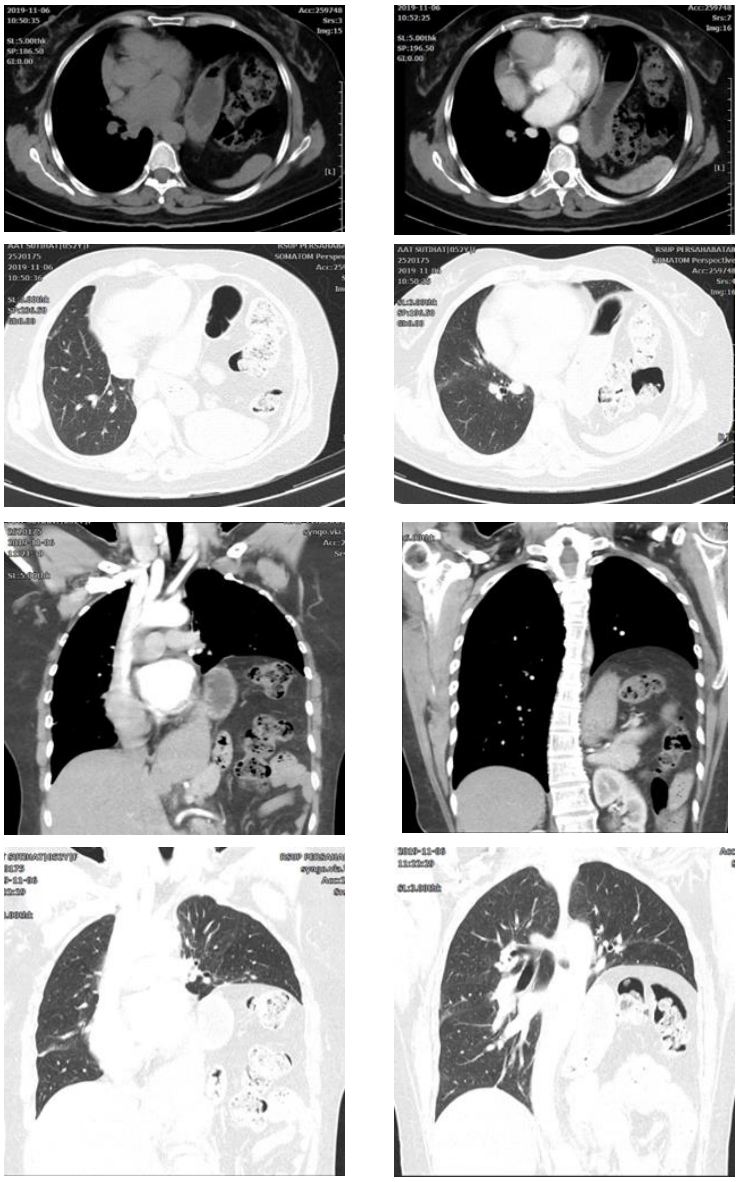

Figure 2. A contrast-enhanced thoracic CT scan shows no visible mass in the lungs, no enlargement of the mediastinal lymph nodes, and the heart is positioned more to the right with a high left diaphragm. The conclusion is consistent with left diaphragm eventration.

ment, atrophy, or congenital absence of diaphragmatic muscle results in eventration of the diaphragm.[7] A developmental abnormality causes true diaphragmatic eventration. Adults may also get eventration, most likely as a result of phrenic nerve injury.[2] Similar to paralysis, eventration of the diaphragm is characterized by an area of weakness and thinning of the diaphragm. In infancy, eventration may result in elevation of a large portion of the diaphragm. Elderly individuals often have diaphragm anomalies that are localized and cause a lobulated appearance, although they are not pathologically significant.[8] Diaphragmatic eventration primarily affects the left hemidiaphragm, is more prevalent in males, and is rare (incidence <0.05%).[3] Furthermore, left-sided agenesis occurs in 88–97% of hemi-diaphragm agenesis cases. The average age at which the diaphragm eventration in adults is 41.86, with a male majority.[9] However, our patient is a 37 year old female with involvement of left side of hemidiaphragm with no significant medical history and trauma. The exact cause in our case is still unknown.

Figure 3. Post-operative plain chest radiograph showed the normal position of the right and left diaphragm. Left pleural effusion was observed with a chest tube being attached

Most adult patients with diaphragmatic eventration are asymp-tomatic, Most patients have an elevated hemidiaphragm that was unintentionally found during a chest roentgenogram. Dyspnea is the main symptom that people with diaphragm eventration encounter. In certain patients, orthopnea develops. Other patients may experience nonspecific gastrointestinal symptoms as belching, nausea, constipation, reflux, bloating, heartburn, epigastric dis-comfort, and weight loss (particularly those with left hemidiaphragm eventration).[4] In our case, the patient admitted to the hospital with dyspnea, epigastric pain and discomfort after meals which are typical findings in left hemidiaphragm eventration. Eventration in this case is suspected after all other causes have been ruled out, and discovered incidentally from initial chest plain radiograph.

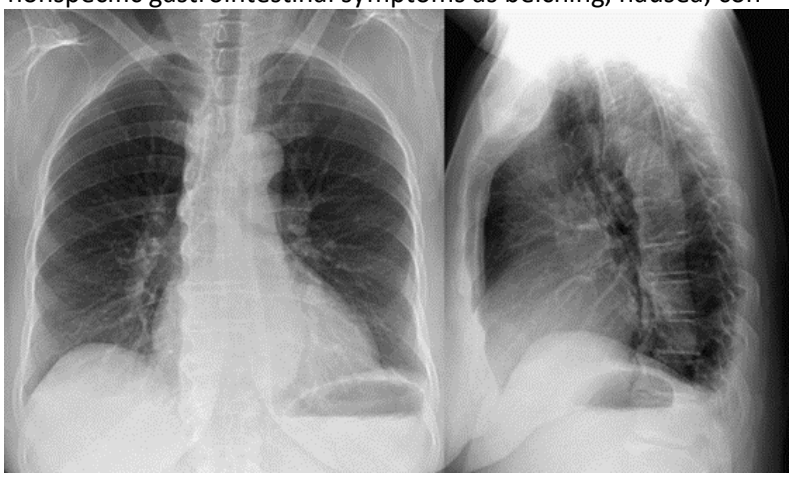

Figure 4. PA and lateral chest radiograph of a partial eventration of the right anterior diaphragm. The anteromedial right diaphragm demonstrates a broad, smooth upward bulging.[11]

The history, chest X-ray, and physician's clinical acuity are the main diagnostic tools used in the diagnosis of symptomatic hemidiaphragm eventration. The main imaging technique used to diagnose eventration is chest radiography.[9] A chest X-ray is a quick and efficient way to assess the lung parenchyma and look for other dyspnea reasons.[10] Both a partial and a complete eventration can be seen on chest radiographs.[11] Eventration appears as a raised section of the hemidiaphragm with a normal height in the remaining portion on radiogra-

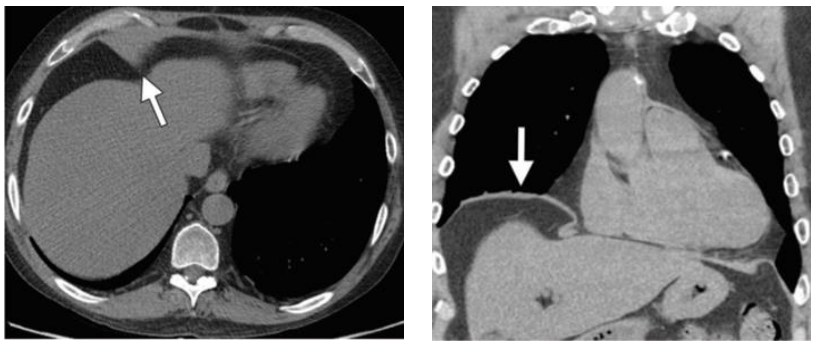

Figure 5. Eventration of right hemidiaphragm. Axial (Left) CT images show eventration of the edge of the right hemidiaphragm (arrows). Coronal (Right) CT images show right hemidiaphragmatic eventration (arrows).5

phy (Figure 4).[5] This is a generic sign, though, as elevation of the hemidiaphragm can also result from a number of pulmonary (such as atelectasis and fibrosis), pleural (such as pleural effusions and masses), and subdiaphragmatic (such as hepatomegaly, splenomegaly, gastric dilatation, and subphrenic abscesses) conditions. Therefore, if a raised hemidiaphragm is seen on a chest X-ray while dyspnea is present, additional research may be required.[4] A plain chest radiograph can show up to 90% sensitivity in cases of unilateral diaphragmatic paralysis, but only 44% specificity.[12]

Sometimes it's necessary to distinguish a partial eventration from a tumor or hernia; in these cases, an MRI or CT scan can be utilized to assess the type of bulge. At CT, there may be a sharp transition at the edge of the eventration. Sometimes the edges are undercut with ballooning above. Radiography and CT scans can typically distinguish eventration from paralysis, albeit it can occasionally be misinterpreted for a diaphragmatic hernia.[5] Diaphragmatic function is typically not assessed by standard computed tomography (CT) scanning of the thorax. CT, however, could be useful in evaluating subdiaphragmatic processes that underlie diaphragmatic dysfunction or elevation shown on a conventional chest radiograph. These conditions include ascites, organomegaly, ileus, and subdiaphragmatic abscess. Additionally, in cases of suspected obstructive illness, subpulmonic effusion, or pleural thickening, CT may aid in further assessment of the lung parenchyma and pleura.[12]

Dynamic MRI of the chest is another potentially useful technology that is not yet used in ordinary clinical practice. One benefit of this modality is that it produces consecutive images that can be structured to resemble a movie. This may be more helpful than MRI since it shows dynamic changes in the diaphragm during inspiration. One benefit of MRI is that it doesn't use any ionizing radiation. However, financial concerns restrict the usefulness of this imaging modality. Furthermore, compared to other imaging methods like ultrasonography, it is not as portable. In many centers, specialized knowledge in picture interpretation may not be available. It's unclear if MRI provides better or clinically meaningful information that could change how patients are treated.[12]

Ultrasound or fluoroscopy can be used for dynamic imaging to assess diaphragmatic mobility. With the use of these technologies, one may see the movements during forced inspiration or the regular respiratory cycle.[11] Fluoroscopy is a form of functional imaging. It is typically used when a chest radiograph reveals diaphragmatic elevation. Both the examination and the interpretation of the results are straightforward. When the diagnosis is unclear, the main use of a fluoroscopic sniff test is to confirm the existence of a paralyzed diaphragm. Sniff tests are not very useful in differentiating between diaphragmatic paralysis (which typically exhibits paradoxical motion when sniffing) and eventration (which typically does not).[4] The diaphragmatic excursion of patients is measured and they are instructed to sniff during the fluoroscopy. Diaphragm motion is normally caudal. Paradoxically, the diaphragm may move cranially in patients with hemidiaphragmatic paralysis. However, the diaphragm may also passively rise when a patient sniffs if they have diaphragmatic eventration.[3] While over 90% of cases of unilateral diaphragmatic weakness can be positively identified by the fluoroscopy sniff test, the test is less helpful in identifying cases of bilateral diaphragmatic paralysis. Six percent of patients without diaphragmatic paralysis had false-positive smell test results.[12]

Diaphragmatic movement can be quantitatively and qualitatively assessed using diaphragmatic ultrasonography, a non-invasive, portable, fast, easy, and well-tolerated test with a linear relationship between diaphragmatic movement and inspired volume. Therefore, if there is a possibility that the diaphragmatic movement is failing, ultrasound has been recommended as the preferred method of assessment.[10] Ultrasound (US) shows about 80% concordance with fluoroscopy findings and can be used to evaluate the thickness and change in thickness of the diaphragm during respiration. Nevertheless, there is no clinical validation for ultrasound.[4] Ultrasonography does, however, have some limitations. Due to the narrow field of view and potential for lung or bowel air to interfere, it is operator reliant and highly skilled. Diaphragmatic movement may be obscured by these organs, making it challenging to evaluate diaphragm function.[4]

Surgical management of eventration of diaphragm is recommended in symptomatic patients.[10] Diaphragmatic plication can be performed using open thoracotomy, laparoscopic, robotic-assisted, or video-assisted thoracoscopic surgery (VATS).[4] In fourteen out of fifteen patients in a research by Tiryaki et al., the diaphragm position was normal following plication. Following an open transthoracic procedure, the outcomes of a case series suggested persistent improvements in dyspnea scores, patient satisfaction, and PFTs.[13] We decided to undergo surgical management because our patient had dyspnea and epigastric discomfort upon presentation. Her symptoms were alleviated by the treatment, and the post-operative radiograph revealed the left and right diaphragms in their usual positions.

Conclusion

We report a case of a 37 years old female with dyspnea and epigastric discomfort. After radiological examination (chest radiograph and CT scans), the results showed a feature of diaphragm eventration. Then the patient undergo surgical management and the procedure relieved her symptoms and radiological examination showed the diaphragm in normal positions.

There are various methods available in the field of diaphragmatic imaging. Certain methods, like CT and plain chest radiographs, concentrate on the anatomic anomalies of the diaphragm that may indicate dysfunction. Some instruments, including fluoroscopy and ultrasonography, are more appropriate for functional imaging. Only symptomatic individuals with diaphragmatic eventration should undergo surgical management. In order to stop the lung function from further declining, a surgical repair should also be performed.

References

1. McCool FD, Manzoor K, Minami T. Disorders of the Diaphragm. Clin Chest Med [Internet]. 2018 Jun 1 [cited 2024 May 11];39(2):345–60. Available from: https://pubmed.ncbi.nlm.nih.gov/29779594/
2. Black MC, Joubert K, Seese L, Ocak I, Frazier AA, Sarkaria I, et al. Innovative and Contemporary Interventions of Diaphragmatic Disorders. J Thorac Imaging [Internet]. 2019 Jul 1 [cited 2024 May 11];34(4):236–47. Available from: https://pubmed.ncbi.nlm.nih.gov/31206456/
3. Groth SS, Andrade RS. Diaphragmatic eventration. Thorac Surg Clin [Internet]. 2009 Nov [cited 2024 May 11];19(4):511–9. Available from: https://pubmed.ncbi.nlm.nih.gov/20112634/
4. Groth SS, Andrade RS. Diaphragm plication for eventration or paralysis: a review of the literature. Ann Thorac Surg [Internet]. 2010 Jun [cited 2024 May 11];89(6). Available from: https://pubmed.ncbi.nlm.nih.gov/20493999/
5. Nason LK, Walker CM, Mcneeley MF, Burivong W, Fligner CL, David Godwin J. Imaging of the diaphragm: Anatomy and function. Radiographics [Internet]. 2012 Mar [cited 2024 May 11];32(2). Available from: https://pubmed.ncbi.nlm.nih.gov/22411950/
6. Grant LA, Griffin N. Grainger & Allison's Diagnostic Radiology Essentials. 2nd ed. Elsevier; 2018. 248–230 p.
7. Klein JS, Brant WE, Helms CA, Vinson EN. Fundamentals of Diagnostic Radiology. 5th ed. Lippincott Williams & Wilkins; 2018. 2553–2556 p.
8. Reed JC. Chest Radiology: Patterns and Differential Diagnoses. 7e ed. Elsevier; 2018. 65–69 p.
9. Dahal A, Singh Y, Ansari A, Karmacharya RM, Vaidya S, Bhatt S. Eventration of diaphragm of unknown cause: A case report. International Journal of Surgery Open. 2023 Aug 1;57:100653.
10. Ricoy J, Rodríguez-Núñez N, Álvarez-Dobaño JM, Toubes ME, Riveiro V, Valdés L. Diaphragmatic dysfunction. Pulmonology [Internet]. 2019 Jul 1 [cited 2024 May 11];25(4):223–35. Available from: https://pubmed.ncbi.nlm.nih.gov/30509855/
11. Roberts HC. Imaging the diaphragm. Thorac Surg Clin [Internet]. 2009 Nov [cited 2024 May 11];19(4):431–50. Available from: https://pubmed.ncbi.nlm.nih.gov/20112626/
12. Kharma N. Dysfunction of the diaphragm: imaging as a diagnostic tool. Curr Opin Pulm Med [Internet]. 2013 Jul [cited 2024 May 11];19(4):394–8. Available from: https://pubmed.ncbi.nlm.nih.gov/23715292/
13. Tiryaki T, Livanelioğlu Z, Atayurt H. Eventration of the Diaphragm. Asian J Surg. 2006 Jan 1;29(1):8–10.