International Journal of Research in Medical Sciences
Hernández-Gómez ED et al. Int J Res Med Sci. 2023 Jan;11(1):344-346
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20223660

Case Report

Approach and management of diaphragmatic paralysis in adults

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Received: 03 November 2022
Revised: 02 December 2022
Accepted: 15 December 2022

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ABSTRACT

3 years ago, 38-year-old male, with no relevant personal pathological history, began to present exertional dyspnea, gastroesophageal reflux, retrosternal pyrosis, dyspepsia and postprandial abdominal distension after a traffic accident. A study protocol was initiated, where cabinet studies documented elevation of the left hemidiaphragm was documented. A minimally invasive approach was performed with the finding of elevation of the left hemidiaphragm of approximately 8 cm in relation to the contralateral diaphragm without evidence of paraesophageal hernia. Mayo type left diaphragmatic plication was performed with non-absorbable suture (polypropylene 1) without complications. With favorable evolution, he started the oral route 8 hours postoperatively, and was discharged 48 hours after surgery due to clinical improvement and without gastroesophageal reflux. Surgical plication of the affected hemidiaphragm is successful in carefully selected patients with severe symptoms thought to be due to unilateral diaphragmatic paralysis. Studies demonstrate improvement in several parameters, including lung and respiratory muscle function, exercise endurance, blood gas exchange, and possibly dyspnea.

Keywords: Diaphragmatic paralysis, Phrenic nerve, Forced expiratory volume, Functional residual capacity, Diaphragm plication

INTRODUCTION

The diaphragm is the most important inspiratory muscle in the body and plays an important role in ventilation and gas exchange. It so serves as a mechanical barrier between the abdominal and thoracic cavities and maintains the pressure gradient between these. Disruption or injury to one of the phrenic nerves or branches results in unilateral partial or complete diaphragmatic paralysis, respectively.[1] Diaphragmatic plication is effective in 90% of patients who undergo this procedure. Diaphragmatic paralysis can be unilateral or bilateral; unilateral paralysis is the most common. It is caused by idiopathic factors reported in up to 20%, tumor invasion in 5% or nerve damage from cardiothoracic surgery in 20% of cases.[1]

Some previous reports have indicated that phrenic nerve injury is most commonly caused by mechanical trauma. It has been shown that the response to treatment in hemidiaphragmatic plication produces an improvement in pulmonary spirometry, dyspnea and functional status in the vast majority of patients. This persists at long-term follow-up improving mean forced vital capacity, forced expiratory volume in 1 second, functional residual capacity and total lung capacity by 19%, 23%, 21% and 19% ($p<0.005$), respectively, when measured 6 months after surgery. Response to treatment in hemidiaphragmatic plication has been found to produce in the vast majority of patients an improvement in pulmonary spirometry, dyspnea and functional status that persists at long term follow up improving mean forced

vital capacity, forced expiratory volume in 1 second, functional residual capacity and total lung capacity improved by 19%, 23%, 21% and 19% ($p<0.005$), respectively, when measured 6 months after surgery. In intermittent symptoms with acute reversible disease, transient ventilatory support may be used. Occasionally these patients with diaphragmatic paralysis develop respiratory failure, for example due to intercurrent infectious diseases, asthma exacerbations or chronic obstructive pulmonary disease. Such individuals may require temporary ventilatory support with noninvasive or invasive mechanical ventilation.[2]

CASE REPORT

3 years ago, 38-year-old male, with no relevant personal pathological history, began to present exertional dyspnea, gastroesophageal reflux, retrosternal pyrosis, dyspepsia and postprandial abdominal distension after a traffic accident. He was pharmacologically managed with proton pump inhibitor and prokinetic, but without improvement, a study protocol was initiated, where cabinet studies documented elevation of the left hemidiaphragm was documented. Diaphragm plication was performed with Mayo technique presenting clinical improvement after surgery, so he was discharged with follow-up by the outpatient clinic.

The following studies were performed:

Panendoscopy: parahiatal hernia, erosive gastropathy, with pathology report of mild chronic reflux esophagitis and mild chronic gastritis, without activity.

pHmetria: DeMeester score (DMS) 3.4. concludes: no pathological acid gastroesophageal reflux, normal exposure to reflux detected by impedance.

Esophageal manometry: LES of 3 cm, mean LES pressure of 27.7, concludes lower esophageal sphincter with normal pressures and IRP, normal esophageal peristalsis, normal pharyngoesophageal coordination.

Chest X-ray: elevation of the left hemidiaphragm (Figure 1).

Abdominal CT: the left hemidiaphragm is elevated 8.2 cm above the level of the right hemidiaphragm, which shows less than the anterior third of its belly with a thickness of up to 10 mm at the level of the contralateral, and immediately posterior shows progressive thinning of 1.5 mm in thickness at the cusp and towards posterior and lateral insertions (Figures 2 and 3).

RESULTS

A minimally invasive approach was performed with the finding of elevation of the left hemidiaphragm of approximately 8 cm in relation to the contralateral diaphragm without evidence of paraesophageal hernia. Mayo type left diaphragmatic plication was performed with non-absorbable suture (polypropylene 1) without complications. With favorable evolution, he started the oral route 8 hours postoperatively, and was discharged 48 hours after surgery due to clinical improvement and without gastroesophageal reflux (Figures 4 and 5).

Figure 1: Chest X-ray showing elevation of the left hemidiaphragm and gastric chamber.

Figure 2: Abdominal CT coronal reconstruction with 8 cm elevation of the hemidiaphragm in relation to the contralateral one.

Figure 3: Abdominal CT coronal reconstruction with 8 cm elevation of the hemidiaphragm in relation to the contralateral one.

Figure 4: Minimally invasive approach in which the elevation of the left hemidiaphragm is observed, causing traction of the stomach, omentum and transverse colon.

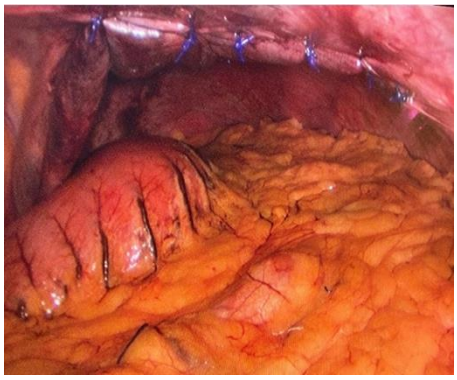

Figure 5: Left hemidiaphragm plication with Mayo technique.

DISCUSSION

Diaphragmatic paralysis is a rare entity in which during inspiration, the unaffected diaphragm moves downward to draw air into the lungs through the trachea. However, air also passes through the thorax from the affected side into the unaffected lung, resulting in a paradoxical movement of the affected hemidiaphragm. This upward movement results in basal atelectasis and impaired gas exchange in that portion of the ipsilateral lung, which reduces the amount of airflow from the paralyzed to the normal side.[1,2]

For the diagnosis it is possible to perform radiography in which elevation of the hemidiaphragm is present, which makes it necessary to perform radioscopy with sniff by rapid movements of nasal aspiration and control of the diaphragmatic fall, with a minimum limit of 2 cm and false positives no greater than 6-7%.[3]

Diaphragmatic plication involves creating folds in the diaphragm and suturing them in place to reduce the paradoxical mobility of the paralyzed hemidiaphragm during inspiration after plication, so that the paralyzed hemidiaphragm no longer moves paradoxically upward in the hemithorax during inspiration. Consequently, the synchrony of the abdominal rib cage improves bilaterally, allowing the adjacent lung segments on the affected side to expand adequately and improve gas exchange. In addition, the healthy hemidiaphragm puts fewer stresses on itself, making it less susceptible to fatigue and decreasing the need to recruit accessory ventilatory muscles.[1,4]

These patients received significant benefits from diaphragm plication, including decreased dyspnea, improved pulmonary spirometry, a trend toward less frequent airway-associated hospitalizations, and a frequent return to work.[5]

CONCLUSION

Surgical plication of the affected hemidiaphragm is successful in carefully selected patients with severe symptoms thought to be due to unilateral diaphragmatic paralysis. Studies demonstrate improvement in several parameters, including lung and respiratory muscle function, exercise endurance, blood gas exchange, and possibly dyspnea.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Hernández-Gómez ED, Choncoa-Valderrama Y, Cruz-Corzo LE, Cerrillo-Avila J, Sánchez-Reyes K. Approach and management of diaphragmatic paralysis in adults. Int J Res Med Sci 2023;11:344-6.