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Successful treatment of phrenic nerve injury with diaphragmatic plication 5 years after onset: A case report

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Abstract

Diaphragmatic paralysis due to phrenic nerve injury is an occasional complication of cardiothoracic surgery. Although diaphragmatic plication is widely used to treat patients with severe irreversible symptoms, its surgical indication and timing remain controversial. Here, we present a rare case of diaphragmatic paralysis in a 65-year-old woman who underwent cardiac surgery and whose respiratory symptoms worsened despite >5 years of conservative management. Consequently, she underwent diaphragmatic plication using an endostapler to resect the redundant diaphragm, followed by over-suturing of all staple lines. She was discharged without any complications and her symptoms and chest radiography and spirometry results improved postoperatively.

Keywords

Diaphragmatic plication, diaphragmatic paralysis, postoperative complication, phrenic nerve injury

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Introduction

Diaphragmatic paralysis is an occasional iatrogenic complication of cardiothoracic surgery or bronchial artery embolization[1,2] that restricts the quality of life caused by chronic dyspnea, orthopnea, recurrent respiratory infections, or digestive symptoms.[3,4] Although diaphragmatic plication (DP) is widely used to treat such cases, its surgical indication and timing remain controversial.[3,5,6] Here, we report a case of successful DP performed 5 years after the onset of phrenic nerve injury. We also discuss the difficulties and disadvantages of long-term conservative management in such cases.

Case report

A 65-year-old woman with a body mass index of 30.3 kg/m^2 was referred to our hospital for respiratory failure associated with diaphragmatic paralysis. Chest radiography at this time showed elevated right hemidiaphragm (Figure 1(a) and (b)). A preoperative chest computed tomography (CT) revealed a leftward shift of the mediastinum, elevated liver position, and atelectasis in the right lower lobe (Figure 1(c)). These findings and the fact that her echocardiography was normal (ejection fraction, 75.9%; no asynergy) led to the diagnosis of dyspnea secondary to diaphragmatic paralysis. Five years previously, the patient had undergone minimally invasive mitral valvuloplasty for mitral regurgitation at another hospital. After the surgery, chest radiography revealed elevated right hemidiaphragm, indicating right diaphragmatic paralysis caused by intraoperative phrenic nerve injury. She experienced deteriorating dyspnea and difficulty maintaining a bent-over position. Eventually, adaptive servo-ventilation was required while sleeping. As her symptoms worsened despite conservative management for >5 years, DP was performed.

The surgery was performed via a 6 cm mini-thoracotomy in the right sixth intercostal space with a camera port. A

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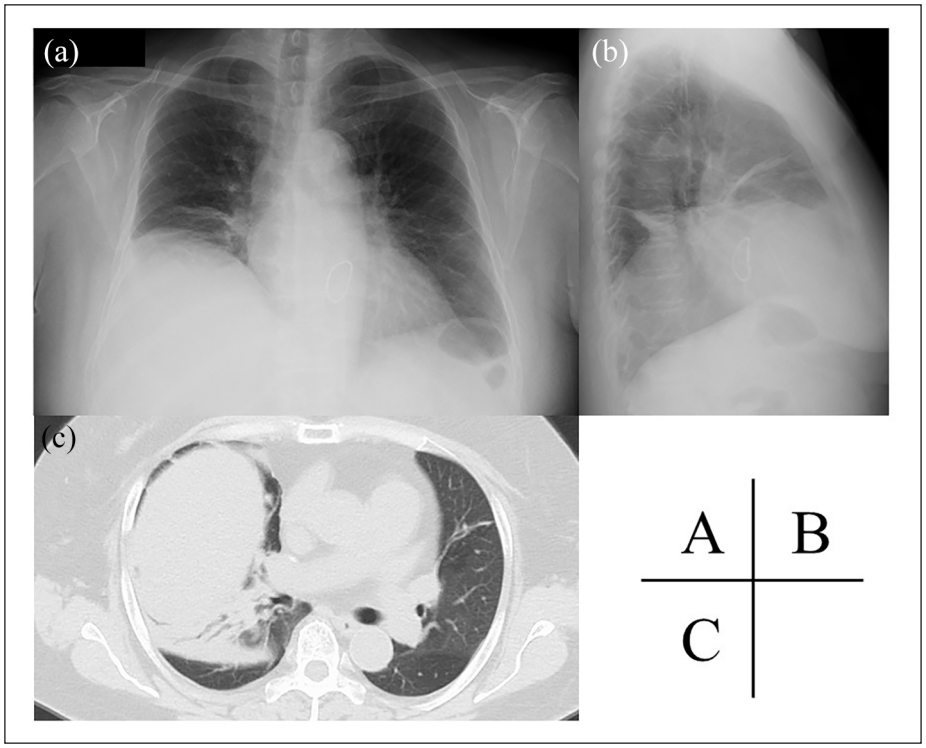

Figure 1. Preoperative chest radiography showed elevation of the right hemidiaphragm in both the (a) posteroanterior and (b) lateral views. (c) Preoperative chest computed tomography scan revealed a leftward shift of the mediastinum, elevated liver, and atelectasis in the right lower lobe.

mini-thoracotomy instead of completely thoracoscopic DP was chosen because the elevated liver had to be pushed down to the caudal side via the diaphragm to secure a better surgical view. Two parts of the thin, redundant diaphragm were resected using an endostapler. Then, both staple lines were reinforced by over-suturing with 3-0 Prolene because of the risk of rupture with the use of only a stapler. Two other areas in the redundant diaphragm were plicated via direct suturing only. The patient was discharged after rehabilitation on postoperative day 20 without any complications.

Chest radiography showed improvement in diaphragmatic elevation, particularly in the lateral view (Figure 2(a) and (b)). The patient's postoperative vital capacity, forced vital capacity, forced expiratory volume at 1 s, and functional residual capacity improved by 13%, 17%, 15%, and 6%, respectively. The patient's atelectasis resolved and her total lung volume on CT scan increased by 36% and 45% at 2 weeks and 9 months, respectively, after surgery (Figure 2(c)). Most importantly, nearly all preoperative symptoms improved. Moreover, she no longer required a respiratory support system when sleeping.

Discussion

Diaphragmatic paralysis is correlated with respiratory disorders and reduced quality of life caused by dyspnea, insomnia, and digestive symptoms.[3] Although the surgical indication for DP remains unestablished, previous reports have shown that patients experiencing dyspnea for at least 6 months[7,8] and those experiencing difficulties in weaning off mechanical ventilators[5,6] are good candidates.

The timing of DP has also been controversial. Most studies have reported that DP should be delayed by 1–2 years to facilitate spontaneous nerve recovery.[3,5,6,9] One report revealed that patients who underwent DP >4 years after conservative management showed poor improvement.[7] In our case, DP was performed 5 years after diaphragmatic paralysis and the patient was satisfied with the resultant improvement in nearly all of her symptoms, suggesting that DP may be useful to treat phrenic nerve injury in some cases, even if many years have elapsed since the injury. However, in this case, earlier intervention could have been more effective because the patient's obesity exacerbated an irreversibly stretched and vulnerable diaphragm and cranially elevated the liver, making surgery more difficult.

Conclusion

We presented a case in which DP was successful in treating diaphragmatic paralysis 5 years after phrenic nerve injury. If symptoms progress every year, surgery must be considered. However, we suggest that DP should only be performed until 3 years after onset because surgery becomes more complex

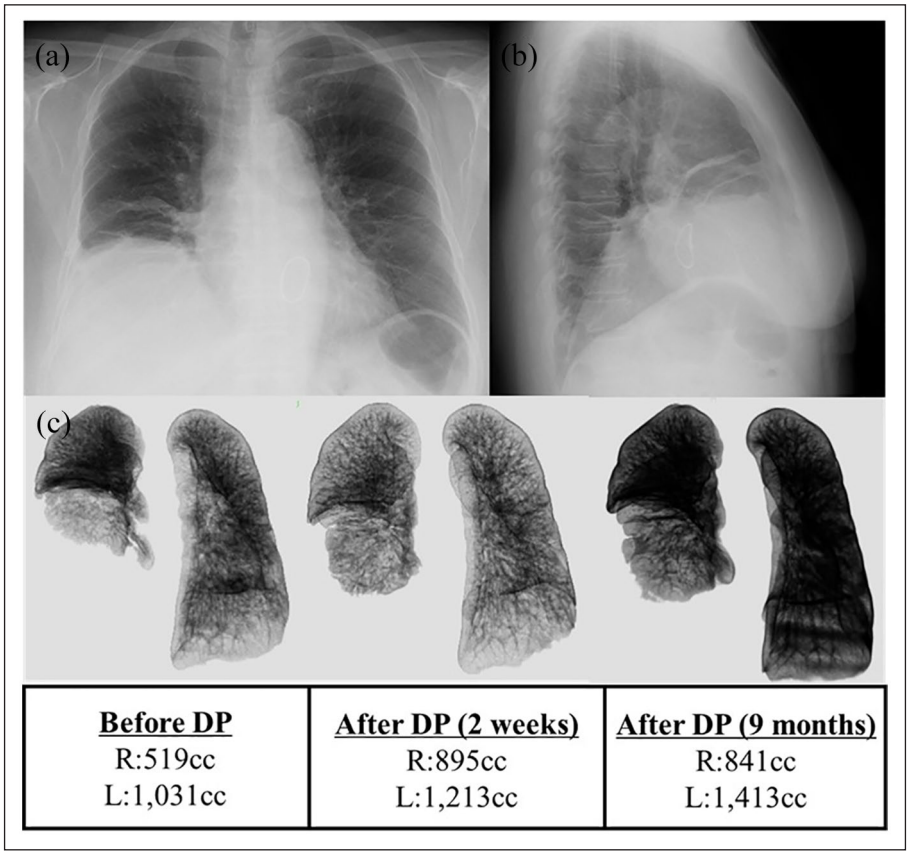

Figure 2. Postoperative chest radiography showed improvement in the placement of the right hemidiaphragm in the (a) posteroanterior and, notably, the (b) lateral views. (c) Postoperative lung volume measured using computed tomography was increased (left: before diaphragmatic plication (DP), middle: 2 weeks after DP, and right: 9 months after DP).

over time owing to the exacerbation of a stretched and vulnerable diaphragm and irreversible cranial elevation of the abdominal organs.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

Our institution does not require ethical approval for reporting individual cases or case series.

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Informed consent

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