Phrenic nerve interposition in a completely portal robotic thymectomy

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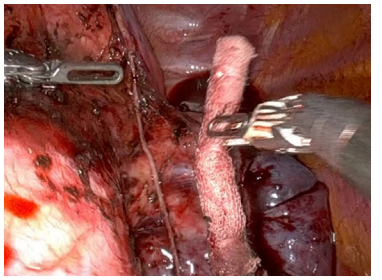


A reconstructed phrenic nerve using an intercostal nerve graft after robotic thymectomy.

CENTRAL MESSAGE

Robotic-assisted surgery may be useful in reconstructive procedures. This report demonstrates the technical tips for phrenic nerve interposition in a completely portal robotic thymectomy.

Video clip is available online.

Robotic-assisted surgery allows precise and stable surgical manipulation owing to its dexterity and magnified stereoscopic view during minimally invasive surgery. These characteristics can facilitate the anastomosis of small and delicate structures, such as bile duct anastomosis or coronary artery bypass surgery.[1] However, reports on robotic-assisted nerve reconstruction are limited despite its theoretical advantages. Here, we report a case of robot-assisted thymectomy with reconstruction of the phrenic nerve using a segmental intercostal nerve graft, taking advantage of the benefits of robot-assisted surgery. Institutional review board approval was waived, and a consent form for publication of study data was obtained.

CASE SUMMARY

A 60-year-old man presented with an anterior mediastinal mass (38 × 18 × 67 mm), detected on chest computed tomography during a medical checkup, which was suspected to be a thymoma (Figure 1 and Video 1). Symptoms of myasthenia gravis were absent, and antiacetylcholine receptor antibodies were negative. Robot-assisted thymectomy via a subxiphoid approach was planned. The Da Vinci Xi (Intuitive Surgical) robotic system was used. The port placement is shown in Figure E1. The camera was inserted through the subxiphoid incision for thymectomy and then switched to the left medial port for phrenic nerve reconstruction using the port-hop function.

First, both chest cavities were opened and insufflated with carbon dioxide at 8 mm Hg. The left upper lobe, which was firmly attached to the tumor, was stapled off. The left

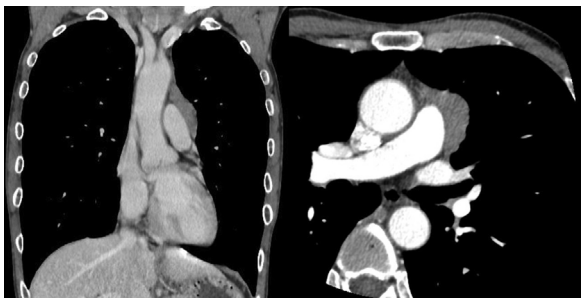
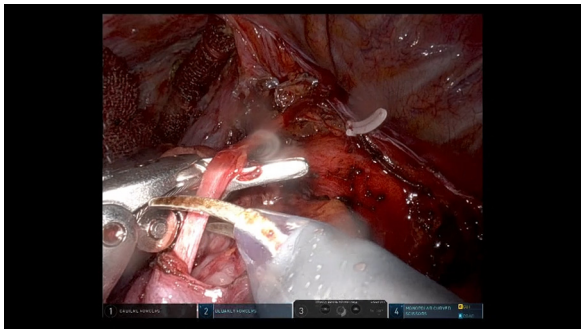


FIGURE 1. Chest computed tomography showing an anterior mediastinal mass.



VIDEO 1. The video demonstrates the technical aspects of robot-assisted thymectomy and phrenic nerve reconstruction using an intercostal nerve graft. Pre- and postoperative evaluations are shown. Video available at: https://www.jtcvs.org/article/S2666-2507(23)00071-8/fulltext.

phrenic nerve was encased in the tumor, and approximately 4 to 5 cm of the nerve was transected. Thymectomy was completed with the specimen removed in a bag. A silk thread was cut to the length of the left phrenic nerve defect (Figure 2, *A*), and the required length of the intercostal nerve graft was marked on the chest wall in the right third intercostal space (Figure 2, *B*). The intercostal nerve was carefully dissected and harvested segmentally according to the marked length. Using a 6-0 woven suture, the phrenic nerve and intercostal nerve graft were anastomosed (superior cut end of the phrenic nerve to the posterior end of the intercostal nerve graft). The epineural approach was used with a figure-of-8 suture at each end (Figure 2, *C*). Phrenic nerve reconstruction was completed without tension at the anastomotic site (Figure 2, *D*). No postoperative complications occurred. Histopathological analysis of the mass revealed a thymoma (World Health Organization histology type B1-B2; p-stage I or Masaoka stage I). There was no microscopic invasion of the phrenic nerve or lungs.

Chest radiographs at 1 and 3 months after surgery are shown in Figure E2. At 3 months, the left diaphragmatic elevation seemed to have recovered. On the sniff test at 1 month postoperatively, paradoxical movement of the left diaphragm (ie, the left diaphragm was rising while the right diaphragm was falling) was observed. At 9 months, movements of the right and left diaphragms were almost synchronous. The patient experienced mild dyspnea on exertion postoperatively, which improved during follow-up. No signs of recurrence were observed during the study period.

COMMENT

In this report, we describe a case of robot-assisted thymectomy with combined phrenic nerve resection followed by reconstruction using an intercostal nerve graft. To our

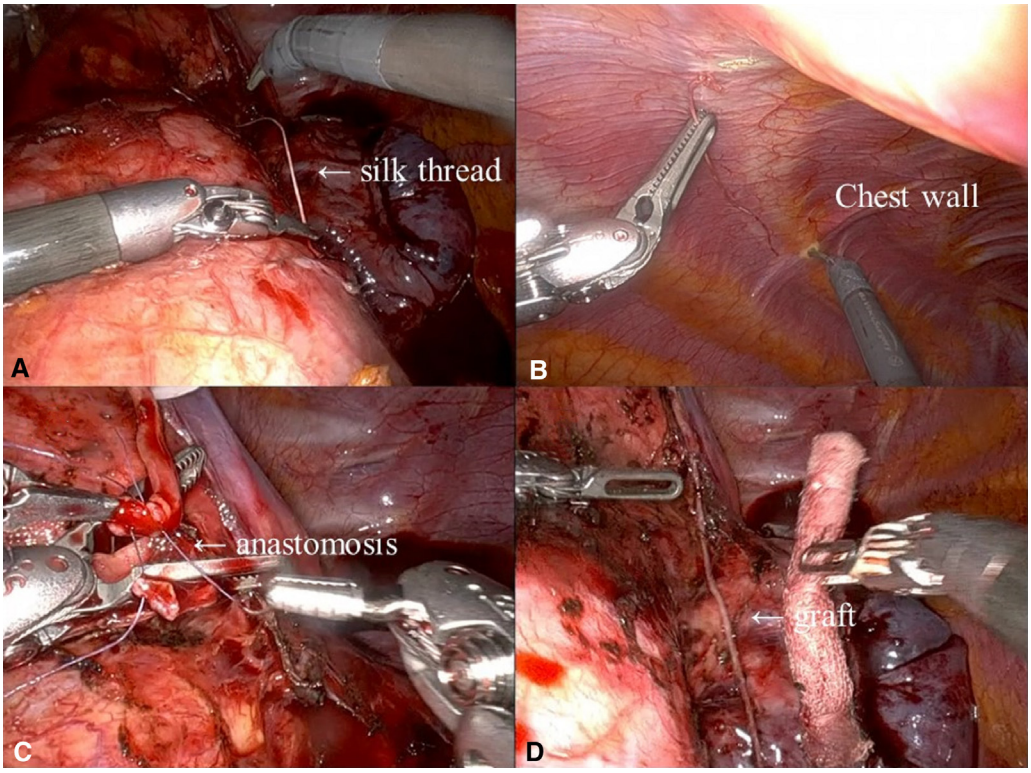


FIGURE 2. Steps of phrenic nerve reconstruction. A, A silk thread was cut to the length of the *left* phrenic nerve defect. B, The required length of the intercostal nerve graft was marked on the chest wall at the *right* third intercostal space using the cut thread. C, Using a 6-0 woven suture, the phrenic nerve and the harvested intercostal nerve graft were anastomosed. D, The phrenic nerve reconstruction was completed without tension on the anastomotic site.

knowledge, this is the first report of robot-assisted phrenic nerve reconstruction.

During thymectomy, en bloc resection of the phrenic nerve is indicated when the nerve is entrapped in the tumor except the patient has poor respiratory function or symptomatic myasthenia gravis because dissecting the phrenic nerve out of the tumor carries a high risk of local recurrence, even with adjuvant radiation therapy.[2] Impaired respiratory function due to unilateral phrenic nerve paralysis can be treated with phrenic nerve reconstruction, which is as effective as diaphragmatic plication.[3] There are several reports of phrenic nerve reconstruction using peroneal nerve grafts during open surgery with a magnifying loupe or microscope.[4] However, only 1 English-language report described 6 cases of phrenic nerve reconstruction using intercostal nerve grafts (n = 3) or direct anastomosis (n = 3) after mediastinal tumor resection during video-assisted thoracic surgery (4-0 monofilament), among which 5 cases showed recovery of diaphragmatic function.[5] Intercostal nerve use was advocated because it can be harvested through the same incisions and its diameter is similar to that of the phrenic nerve. A 6-0 woven thread was believed to be durable and fine enough for robotic nerve reconstruction.

We believe that the use of robotic assistance facilitated the meticulous dissection and anastomosis of the intercostal nerve graft. There was successful diaphragmatic function recovery, as evidenced by the postoperative sniff tests.

CONCLUSIONS

In this case, the dexterity and magnified view provided by the robotic system facilitated phrenic nerve reconstruction. Successful recovery of diaphragmatic movement was observed during postoperative follow-up examinations.

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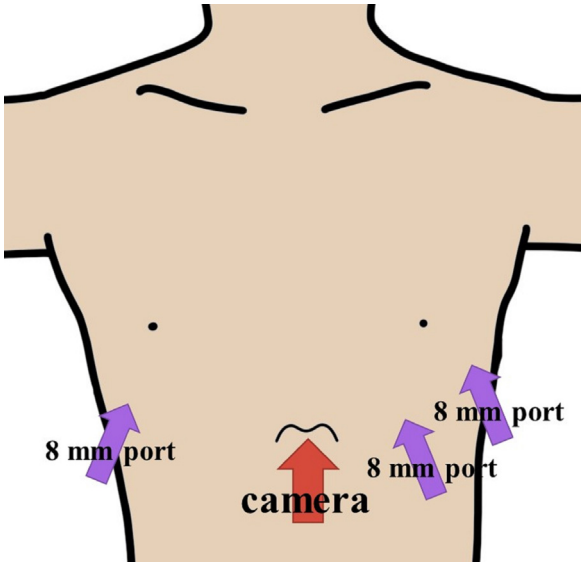

FIGURE E1. Port placement. The camera was inserted through the subxiphoid utility port covered with a single-port surgery device, enabling a completely portal approach with carbon dioxide insufflation. One port was placed at the midclavicular line in the *right* sixth intercostal space. Other ports were placed at the midclavicular line and anterior axillary line in the *left* sixth intercostal space.

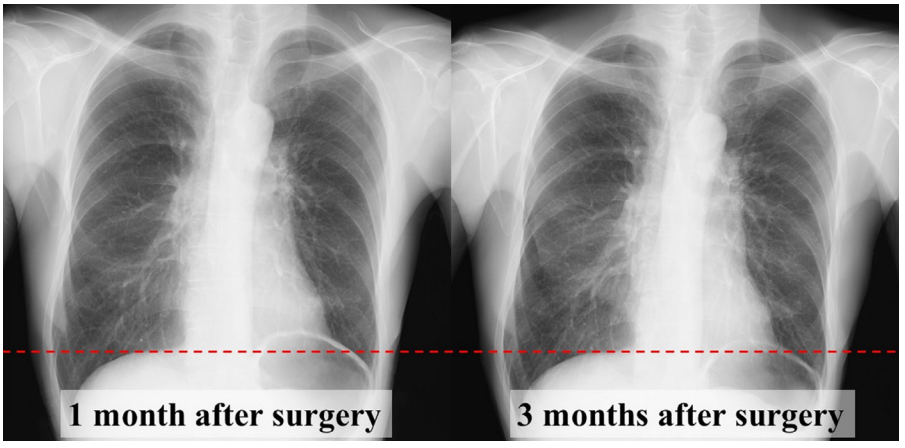

FIGURE E2. Chest radiographs at 1 month and 3 months after surgery. *Left* diaphragm elevation seems to be improving.