The technical aspects of a midline robotic thymectomy

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▶ Video clip is available online.

In the treatment of early-stage thymomas or myasthenia gravis, minimally invasive thymectomy, including robotic approach, has gained popularity. Several approaches are proposed for robotic thymectomy, including the left,¹ right,² bilateral,³ and subxiphoid.⁴ The robotic subxiphoid approach was originally described by Suda and colleagues,⁴ who demonstrated its feasibility and safety. We aim to demonstrate the advantages of a subxiphoid approach in robotic thymectomy.

METHODS

This is a single institutional retrospective study. Cases of robotic thymectomy for thymic epithelial malignancies (Masaoka-Koga stage 1 or 2) between October 2018 and November 2019 were included. All procedures (robotic-portal anterior mediastinal operation using 4 arms) were performed with a single operator (K.H.) with the da Vinci Xi surgical system (Intuitive Surgical, Sunnyvale, Calif). The visualization of the bilateral phrenic nerves (Figure 1, A), and the identification of trachea and brachiocephalic artery after dissection of the upper poles (suggesting complete dissection of the poles during procedures; Figure 1, B) by the unilateral approach (Lat group) and the subxiphoid approach (SubX group) were compared. This study was approved by the institutional review board (Ashikaga: No 2019-44) on February 5, 2020, and consent was waived.

Procedure

The procedure is demonstrated in Video 1. To summarize, the patient was positioned supine with arms and legs open. A 3-cm incision was made in the subxiphoid lesion. A single-port device was applied to the subxiphoid incision with CO₂ insufflation at 8 mm Hg. Following the opening of the bilateral pleura and the dissection of the thymus off the sternum, 2 ports in the right side and 1 port in the left side were placed at the sixth

Robotic-assisted thymectomy with a midline (subxiphoid) approach.

CENTRAL MESSAGE

In robotic-assisted thymectomy, the midline (subxiphoid) approach is associated with improved visualization of phrenic nerves and facilitates the dissection of the upper poles.

See Commentaries on pages 371 and 373.

intercostal space level (Figure 1, C). A 30-degree robotic camera was mounted in the subxiphoid port. The xiphoid process was not removed but was lifted using a robotic camera port to increase the space behind the sternum. An en-bloc complete thymectomy, including adjacent mediastinal fat, was performed (Figure 1, D). For patients with myasthenia gravis, extended thymectomy was performed.⁵ A single flexible chest tube bridging bilateral chest cavity was placed through the lateral port. A fasciotomy in subxiphoid incision was carefully closed.

RESULTS

A total of 11 robotic thymectomies were performed (Lat, n = 3 [right 2; left 1]; SubX, n = 8). The clinical characteristics were similar between the groups (Table 1: Characteristics). The intraoperative and short-term outcomes are summarized in Table 1, Outcomes. Visualization of the bilateral phrenic nerves (Lat 33% vs SubX 100%) was better in the SubX group. Although the visualization of bilateral upper poles was possible in all 11 cases, the identification of trachea and brachiocephalic artery after dissection (Lat 0% vs SubX 88%) was better in the SubX group. There were no complications (greater than Clavien-Dindo grade 2), phrenic nerve paralysis, or conversion to sternotomy/thoracotomy. Median (range) operation duration (Lat 191 [175-191] vs SubX 144

FIGURE 1. Robotic-assisted thymectomy with a subxiphoid approach. A, Visualization of the bilateral phrenic nerves. In the *left picture*, the right phrenic nerve is visualized and protected while dissecting the right border of the thymus using an energy device. In the *right picture*, the left phrenic nerve is visualized and protected while dissecting the left border of the thymus which includes a nearby thymoma. B, Identification of trachea and brachiocephalic artery after dissection of the upper poles. C, Port placement/incisions for our robotic subxiphoid approach. From the right side of the patient, an 8-mm port in the sixth ICS at the right mid clavicular line, an 8-mm port in the sixth ICS at the right anterior axillary line, a 30-mm subxiphoid incision, and an 8-mm port in the sixth ICS at the left mid clavicular line were placed. D, Extracted thymus including the thymoma. The bilateral upper poles (on the upper part of the screen) and bilateral lower poles (on the lower part of the screen) were completely extracted by en bloc resection. ICS, Intercostal space.

[106-224] minutes), intraoperative blood loss (Lat 60 [12-156] vs SubX 14 [0-60] g) or postoperative hospital stay (Lat 3 [3-3] vs SubX 3 [3-6] days) were similar between the groups. Complete resection of the tumor was achieved in all 11 cases.

DISCUSSION

This study is limited by the small sample size and the retrospective nature. However, we demonstrated the advantages of the subxiphoid approach in terms of visualization of the phrenic nerves and dissection of the upper poles during robotic thymectomy. These advantages are important technical components, particularly for the myasthenic patients, for whom extended thymectomy is recommended.⁵

Although we did not observe in this series, potential disadvantages related to this subxiphoid approach include additional pain due to bilateral port placement and a herniation from subxiphoid incision. Closing fasciotomy completely while putting chest tube in other ports might help avoid herniation.

One might argue that in a unilateral approach, the integration of a second thoracoscopy or a near-infrared fluorescence imaging could facilitate the visualization of the contralateral phrenic nerve. However, we believe that our approach allows for the identification of the bilateral phrenic nerves from the pleural surface for the entire length, which is helpful for adequate dissection along the nerves.

Traditionally, a median sternotomy has been selected over a lateral thoracotomy for thymectomy. It is quite

TABLE 1. Characteristics and outcomes stratified by approach of the robotic thymectomy

	Lateral group (n = 3*)	Subxiphoid group (n = 8)
Characteristics		
Age, y	64 (52-76)	65 (45-71)
Male	3 (100%)	3 (37.5%)
BMI	26.8 (18.5-28.0)	22.3 (18.5-26.3)
% FEV ₁ L	95.0 (77-106)	102.1 (86-122)
Tumor size, mm	22 (13-70)	24 (10-48)
Tumor SUV max on FDG-PET	0 (0-6.3)	3.0 (2.2-4.4)
Thymoma/thymic carcinoma	3/0	7/1
Masaoka-Koga stage 1/2	0/3	4/4
Myasthenia gravis	0 (0%)	3 (37.5%)
Outcomes		
Visualization of the bilateral phrenic nerve	1 (33%)	8 (100%)
Identification of trachea and brachiocephalic artery	0 (0%)	7 (88%)
Conversion rate	0 (0%)	0 (0%)
Complication rate (grade ≥ 2)†	0 (0%)	0 (0%)
Complete resection rate	3 (100%)	8 (100%)
Intraoperative blood loss, g	60 (12-156)	14 (0-60)
Operation duration, min	191 (175-191)	144 (106-224)
Chest tube duration, d	1 (1-1)	1 (1-1)
Postoperative hospital stays, d	3 (3-3)	3 (3-6)

Values are median (range). *BMI*, Body mass index; *FEV*, forced expiratory volume; *SUV max*, maximum standardized uptake value; *FDG-PET*, 18F-fluorodeoxyglucose positron emission tomography. *Lateral group included 2 right-side approaches and 1 left-side approach. †Clavien–Dindo classification.

interesting why many surgeons would consider a lateral approach to be standard when it comes to minimally invasive surgery. We found that a quality view similar to that of a median sternotomy can be acquired with the described approach, which was enabled by technological advancements. Nevertheless, the long-term evaluation of oncologic outcomes and quality of life assessment of this approach are warranted.

VIDEO 1. Technique of robotic thymectomy using a subxiphoid approach. Video available at: [https://www.jtcvs.org/article/S2666-2507\(20\)30425-9/fulltext](https://www.jtcvs.org/article/S2666-2507(20)30425-9/fulltext).

CONCLUSIONS

In robotic thymectomy for early thymomas, the subxiphoid approach is associated with improved visualization of phrenic nerves in both sides and the upper poles.

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