



Trans-subxiphoid robot-assisted thoracoscopic surgery for resecting multiple thymomas: a case report

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Abstract: Among thymomas, multiple thymoma (MT) is known to be a quite rare disease. For resecting MT, trans-subxiphoid robot-assisted thoracoscopic surgery (RATS) was performed. Two resected tumors were found to be type B1 and B2 thymomas, which were diagnosed to be multicentric development type MTs. Minimally invasive surgery was reported to be realized by trans-subxiphoid RATS.

Keywords: Multiple thymoma (MT); robot assisted surgery; subxiphoid approach

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Introduction

Multiple thymoma (MT) is known to be a quite rare disease (1-3). The genesis of MTs may involve both intrathymic metastasis and multicentric tumors. Most of MTs have the same histotype, and the relatively small number of MTs having various histotypes are also found (1-5).

Minimally invasive thymectomy by video-assisted thoracoscopic surgery (VATS) is performed for resecting thymoma. However, the lack of perspective sensation by two-dimensional view and the restricted movements of surgical instruments give difficulty in handling the tissues. Robotic-assisted thoracoscopic surgery (RATS) thymectomy have more technical advantages such as a three-dimensional (3D) vision system and multi-articulated instruments (6). Trans-subxiphoid RATS thymectomy can provide a better surgical view in the upper poles of thymus and bilateral phrenic nerves (7).

Here in, a clinical case where MT with different histotypes were resected by trans-subxiphoid RATS thymectomy was reported.

Case presentation

Patient was a 67-year-old woman who was found to have an

abnormal shadow by chest radiograph during her medical checkup. Computer tomography (CT) found two masses in the anterior mediastinum, and the patient was referred to the authors' hospital. No symptoms including neurological manifestations were found, no abnormal findings were found in laboratory data, and anti-acetylcholine antibody was negative. Chest CT found two circular-like shape masses with sizes of 47 mm × 43 mm and 31 mm × 18 mm, of which surfaces and interior statuses were smooth and homogenous, in the anterior mediastinum (*Figure 1A*), and no contrast effects were observed in the tumors. 18F-fluorodeoxyglucose positron emission tomography (FDG-PET) found two sharply margined and regularly bordered masses in the anterior mediastinum (*Figure 1B*), the right and left side lesions showed fluorodeoxyglucose (FDG) accumulations with a maximum standardized uptake values (SUV_{max}) of 4.80 and 4.21, respectively. No significant swelling of lymph nodes and no abnormal FDG accumulation were observed in the lymph nodes.

The patient was laid in a supine position under general anesthesia and one-lung ventilation, a 4-cm skin incision is made above the subxiphoid, and GelPOINT Mini (Applied Medical, Rancho Santa Margarita, CA, USA) was affixed for a camera scope. Camera scope was inserted with CO₂ gas injection at a pressure of 6 mmHg by an AirSeal[®] intelligent

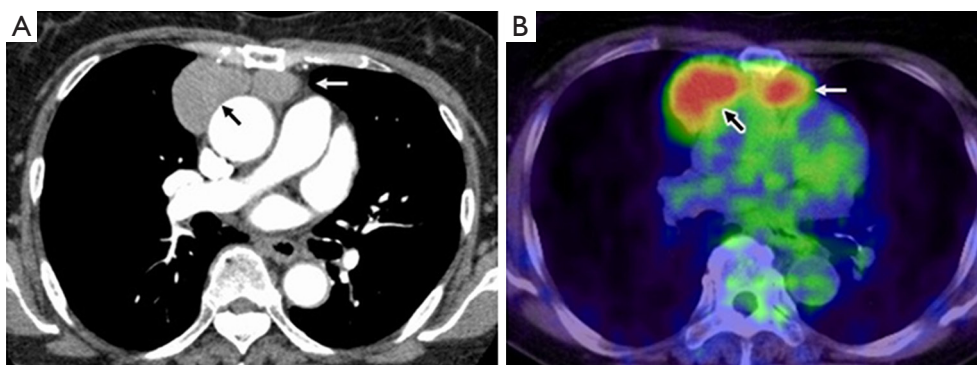


Figure 1 Preoperative imaging findings of a 67-year-old woman. (A) Chest computer tomography (CT) shows two homogeneous and non-enhancement masses. The right tumors (black arrow) and left (white arrow) measure 47 mm × 43 mm and 31 mm × 18 mm, respectively. (B) In 18F-fluorodeoxyglucose positron emission tomography (FDG-PET), the right (black arrow) and left side lesions (white arrow) show fluorodeoxyglucose (FDG) accumulations with maximum standardized uptake values (SUV_{max}) of 4.80 and 4.21, respectively.

flow system (ConMed, Milford, CT). Two 8-mm ports for the da Vinci robotic arm were inserted bilaterally into a 1-cm skin incision in the sixth intercostal space on the mid-clavicular line (*Figure 2A*). The robotic surgical system (da Vinci Xi[®]) (Intuitive Surgical, Sunnyvale, CA) was docked over the left side head of the patient. The da Vinci camera scope was mounted through the subxiphoid port (*Figure 2B*). A monopolar spatula was mounted on the right arm, and a pair of bipolar fenestrated grasping forceps was mounted on the left arm. Appropriately, the spatula was replaced with a bipolar vessel sealing system. Right lobe of thymus including the right side thymoma was separated from the right phrenic nerve and pericardium (*Figure 2C*), and the left lobe of thymus was also separated in the same manner (*Figure 2D*). Two thymomas were resected as a mass with the thymus, which were placed in a bag in the mediastinum and removed through the subxiphoid incision. Silicon tubes with an inner and outer diameter of 4.2 and 6.7 mm, respectively, (Thoracic Catheter, Straight) (REDAX, Poggio Rusco, Italy) were inserted through both the sixth intercostal space ports.

The resected thymomas were found to be oval or ellipse in shape with sizes of 5 cm × 4 cm × 2.5 cm and 5 cm × 3 cm × 1.5 cm (*Figure 3A*), and cells having clearly distinguishable nuclei proliferated with small-size lymphocytes in the tumors (*Figure 3B,C*). Immunohistochemical examination showed that the tumors were positive for CK (AE1/3), CD3, and CD1a (*Figure 3D,E,F,G*). The larger tumor was diagnosed to be type B1 thymoma, because it was rich in lymphocytes, and the smaller tumor was type B2 thymoma because of the proliferation of epithelial cells.

Both thymomas were in the stage II of the Masaoka staging system.

Discussion

MT is reported to be a quite rare disease, which occupies only 1.1–2.2% of whole thymomas (1-3). From 1961, 26 MT cases are reported, and 23 cases have precise record containing thymomas' histotypes and their disease stages. Among them, 19 cases (82.6%) resect two thymomas; 3 cases (13.0%), three thymomas; 1 case (4.3%), six thymomas (5). In the total 53 resected thymomas in 23 cases, the number of type A thymomas is 5 (9.4%); type AB, 12 (22.6%); type B1, 21 (39.6%); type B2, 12 (22.6%); type B3, 1 (1.9%); type B2+3, 1 (1.9%); micronodular thymoma with lymphoid stroma (MNT), 1 (1.9%). In the Masaoka staging system, the number of thymoma at the stage I is 38 (71.7%); the stage II, 13 (24.5%); the stage III, 2 (3.8%).

MT with myasthenia gravis is also reported, and the complication rate is found to be 30.4–37.5% of total number of MT (4,8). Histologically, 65.2–83.0% resected thymomas show the same histotype (2,4,5). As the origin of MT, multicentric development and intrathymic metastasis types are considered. The resected thymomas having different histotypes are diagnosed to be multicentric development type thymomas. However, if the thymoma has the same histotype, it is difficult to diagnose which the origin of tumor is, multicentric development origin or intra-thymic metastasis origin. In previous report, since the nucleus morphology in thymus epithelium and the

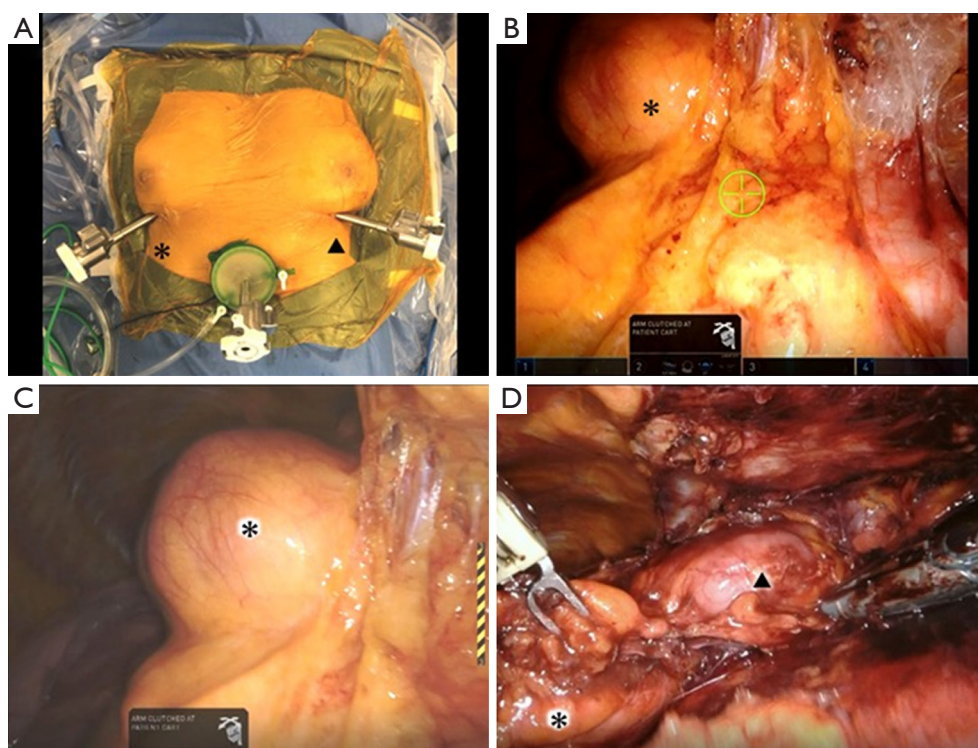


Figure 2 Intraoperative findings. (A) A 4-cm arc incision was made at the subxiphoid area, and an advanced access platform GelPOINT Mini was fixed for a camera port. Two ports for the da Vinci robotic arms were inserted into two 1-cm skin incisions in the left (black arrow head) and right sixth intercostal spaces (asterisk) on the midclavicular line. (B) A camera scope was inserted under pneumothorax created by CO₂ gas injection. The asterisk (*) shows right side thymoma. (C) The right side thymoma was found on the right lobe of thymus, and the asterisk (*) shows the thymoma. (D) The left lobe of thymus including the left side thymoma was separated from the left phrenic nerve by the robotic bipolar vessel sealing system. The asterisk (*) shows the right side thymoma, and the black arrow head (▲) shows the left side thymoma.

effect of immuno-staining on the tumor is identical each other, thymomas are diagnosed as an intrathymic metastasis origin thymoma (9). As the characteristics of multicentric development origin thymomas, the number of thymomas is two, the sizes of the thymomas resemble each other, and the most resected thymomas are diagnosed to be the stage I of the Masaoka stage (10).

As a treatment, thymomas are removed surgically if it resectable. Although thymectomy is conventionally performed by median sternotomy, recently, as a minimally invasive surgical approach, VATS is performed. Compared with conventional median sternotomy, VATS thymectomy is reported to reduce the incidence of postoperative complications, shorten the length of postoperative hospital stay, and give a lower incidence of lung functional deterioration that is frequently observed after conventional median sternotomy (11,12). However, VATS thymectomy

is reported to give a slightly higher incident rate of phrenic nerve damages (6.7%) than that of the conventional median sternotomy (0%) due to poor visual fields on mediastinal fat and phrenic nerves (13). Suda *et al.* reported that subxiphoid approaching VATS gives a better visual field on the superior pole of thymus and phrenic nerves (7).

The robotic surgical system, which can give more flexibility to operating arms with multi-joint forceps, allows surgeons to perform their operating maneuvers easily (6), and RATS for thymomas is reported to be safe and easily performed (12,14). On the other hand, unilateral approaching RATS is mentioned to be difficult to confirm the existence of the brachiocephalic vein in the opposite side of chest. Trans-subxiphoid RATS thymectomy gives a good visual field on the left brachiocephalic vein, and even in a case where the invasion of tumors is suspected, the robotic surgical system allows surgeons to tape the left

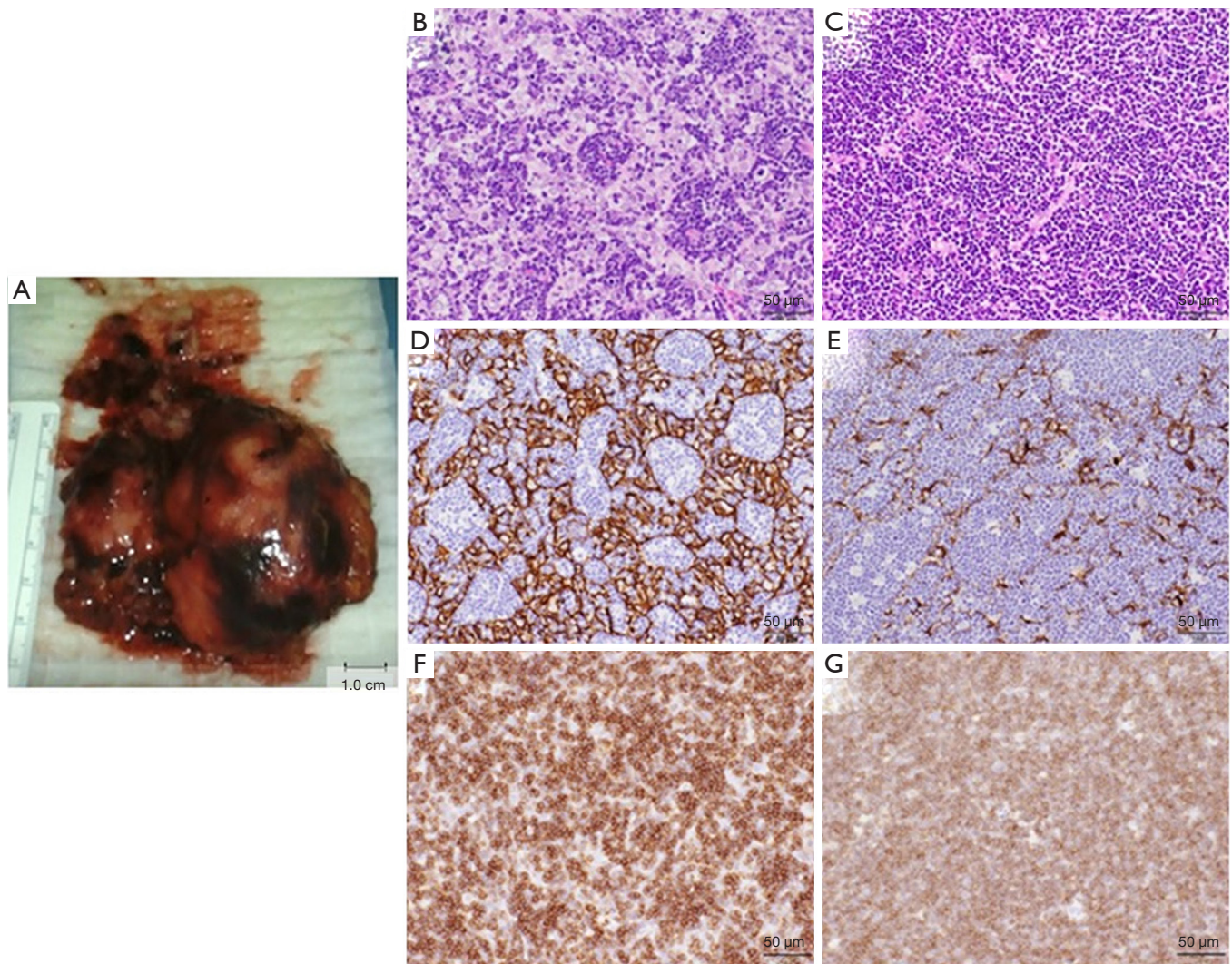


Figure 3 Histopathological findings. (A) Macroscopic appearance of the resected thymoma, which was the back-side view. The photograph was obtained from endoscopic digitalized image data. The scale bar in photograph A indicates 1.0 cm. (B) In the hematoxylin and eosin (HE) stained specimen of the left thymoma, the proliferation of epithelial cells was observed. (C) In HE stained specimen of the right thymoma, predominant lymphocytic form was observed. The epithelial cells of the left tumor (D) and the right tumor (E) were positively stained for CK AE1/AE3. The lymphoid cells the left tumor (F) and the right tumor (G) were positively stained for CD1a. The scale bars in the microphotograph B–G indicate 50 μ m.

brachiocephalic vein.

Moreover, in a case where the invasion is found to reach to the pericardium, the pericardial resection and the reconstruction of pericardium are difficult to be performed by VATS, which is unable to be applied thymectomy. However, RATS, which can maneuver multi-articulated forceps, can perform minimally invasive operation for thymectomy (15).

In this report, trans-subxiphoid RATS thymectomy

was performed for a MT found in the thymic gland. This procedure was confirmed to be applicable for both thoracic cavities and performed quickly and easily with a wide visual field, resulting in the achievement of more minimally invasive surgery.

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Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/vats.2019.06.01>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this manuscript and any accompanying images.

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