Trans-subxiphoid robotic thymectomy

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Abstract

Minimally invasive surgery has replaced median sternotomy for resectable anterior mediastinal masses and is performed by various approaches. We developed a new minimally invasive surgical procedure by combining the subxiphoid approach performed through a midline camera port with the use of a robotic surgery system (Intuitive Surgical, Sunnyvale, CA, USA). A 3-cm transverse incision was made 1 cm below the xiphoid process. Then, a port designed for single-port surgery was inserted. Through this port, CO₂ gas was injected at 8 mmHg. The thymus was then detached from the back of the sternum. A 1-cm skin incision was made bilaterally in the sixth intercostal space, followed by insertion of a port for the robotic system. A camera port was inserted into the subxiphoid port, to which the camera scope was mounted, and thymectomy was performed. We have performed the operation in 3 patients. In our experience, this procedure provides a good operative view in the neck region and makes verification of the phrenic nerve easy. Furthermore, with the da Vinci surgical system, which enables surgical manipulation from a correct angle due to the multijoint robotic arms, trans-subxiphoid robotic thymectomy may be a promising new thymectomy procedure.

Keywords: Thymectomy • Minimally invasive surgery • Thoracoscopy/Video assisted thoracic surgery • Robotics

INTRODUCTION

Minimally invasive surgery has replaced median sternotomy for resectable anterior mediastinal masses and is performed by various approaches [1–3]. One of the drawbacks of the lateral approach for resection of mediastinal tumours is the difficulty in locating the contralateral phrenic nerve and the upper pole of the thymus. We developed a new minimally invasive surgical procedure by combining the subxiphoid approach performed through a midline camera port with the use of the da Vinci multijoint robotic surgery system. Here, we report the surgical procedure in detail and describe 3 cases in whom the procedure was used.

MATERIALS AND METHODS

Artificial respiration was performed under general anaesthesia with a single-lumen endobronchial tube with patients in the supine position with arms and legs open.

Predocking surgical procedure

First, a 3-cm transverse incision was made 1 cm below the xiphoid process, and the fascia of the rectus abdominis muscle was cut vertically, followed by separation of the rectus abdominis muscle from the xiphoid process. There was no need to resect the xiphoid process. The back of the sternum was detached blindly using a finger. Then, an X-gate (Akita Sumitomo Bakelite Co., Akita, Japan) or GelPOINT Mini (Applied Medical, Rancho Santa Margarita, CA, USA) port designed for single-port surgery was inserted through a subxiphoid incision, through which CO₂ gas was injected at 8 mmHg. Detachment of the thymus from the back of the sternum was performed using the LigaSure V device (Covidien, Mansfield, MA, USA) with a 5-mm 30° rigid scope. We then dissected the mediastinal pleura to open up the chest cavity bilaterally. A 1-cm skin incision was made bilaterally in the sixth intercostal space on the anterior axillary line, followed by insertion of a port for the da Vinci Si surgical system (Intuitive Surgical, Sunnyvale, CA, USA).

Trans-subxiphoid robotic thymectomy

The da Vinci surgical system was docked over the head of the patient. A 12-mm camera port was inserted into the subxiphoid port, to which the da Vinci camera scope was mounted. A robotic arm was mounted to the port in the sixth intercostal space bilaterally, with a monopolar spatula on the right arm and bipolar fenestrated grasping forceps on the left arm (Fig. 1). The surgical assistant sometimes operated the Autonomy Grasper 45-cm forceps for single-port surgery (Cambridge Endo, Framingham, MA, USA) for the traction of the thymus through the single port to ensure a sufficient operative field. The thymic vein was cut using a bipolar EndoWrist Vessel Sealer (Intuitive Surgical). After resection, the thymus was placed in a bag in the mediastinum and removed through the subxiphoid incision, followed by insertion of a 20-Fr drain through the same port (Video 1).
RESULTS

We first performed this operation in February 2014 and to date have performed it in 3 patients, the outcomes of which are presented in Table 1. Preoperative work-up included computed tomography (CT) and magnetic resonance imaging (MRI). Endoscopic surgery was contraindicated in all 3 patients because the imaging findings revealed contact between the tumour and the left phrenic nerve in patient 1, the pericardium in patient 2 and the brachiocephalic vein in patient 3, indicating possible tumour infiltration. No preoperative biopsy was performed. Trans-subxiphoid robotic thymectomy was indicated because this highly manoeuvrable robot-assisted surgery enables the handling of intraoperative events, for example, by concurrent resection. Intraoperative findings showed no tumour infiltration and the easy dissociation of tumour from the nearby organs. The patients had no postoperative complications and little pain and were discharged on postoperative day 2 or 3. Postoperative pathological findings verified the complete resection of the tumour in all 3 patients. Patient 2 underwent the surgical procedure after preoperative radiological findings suggested no contraindications (e.g. a high-grade malignancy). However, thymic carcinoma was diagnosed after surgery based on pathological findings. In this patient, postoperative radiotherapy was performed. As of this writing, the patients have been followed for 7–10 months (mean 8.3 months) after surgery. CT imaging performed at 3 months postoperatively and every 6 months thereafter has shown no signs of recurrence.

DISCUSSION

Our previously reported single-port thymectomy (SPT) is a patient-friendly technique that causes minimal pain and provides
good aesthetic outcomes [4]. For surgeons, however, the surgical procedure is technically demanding [5]. We developed this new technique by combining the subxiphoid approach performed through a midline camera port with the use of the da Vinci multi-joint robotic system to ensure a clear operative view and improved manoeuvrability as a minimally invasive surgical procedure for patients untreatable with SPT. Compared with SPT, the present approach is associated with a higher risk of intercostal nerve damage due to intercostal penetration by the right and left arm ports. Another major drawback of da Vinci-assisted surgery is its associated cost. Since we are fully familiar with the SPT procedure, we are still performing SPT on tumours not adjacent to blood vessels or nerves, as it is the least invasive procedure for patients.

This is the first study to apply the da Vinci surgical system to thymectomy via a subxiphoid approach. Inserting a camera through a midline port makes it easier to identify the upper pole of the thymus in the cervical region and the bilateral phrenic nerves. The fact that the thymus, the surgical target, is located between both arms further makes surgical manipulation easier.

In our experience, this procedure provides a good operative view in the neck region and makes verification of the phrenic nerve easy. Furthermore, with the da Vinci surgical system, which enables surgical manipulation from a correct angle due to the multijoint robotic arms, trans-subxiphoid robotic thymectomy may be a promising new thymectomy procedure.

Conflict of interest: none declared.

REFERENCES