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Can the da Vinci robotic system be alternative to open surgery for schwannoma in posterior mediastinum?

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Abstract:

OBJECTIVE: In the present study, the outcomes and technical details of patients who underwent surgical resection for benign schwannoma with the da Vinci robotic system are presented.

MATERIALS AND METHODS: In the scope of our robotic surgery program, 26 (8.7%) patients out of 296 patients were operated using the da Vinci robotic system. Five patients (19.2%) who underwent surgery of benign schwannoma were included in the study. Prospectively, collected data of these patients were retrospectively evaluated. Age, gender, robot docking and console times, length of hospital stay, anatomic localizations of the lesions, pathology results, blood infusion needs, and mortality and morbidity rates of the patients were recorded.

RESULTS: All patients were male, and the mean age was 43.2 ± 12.1 years. The mean length of hospital stay was 3 ± 0.9 days. The mean console time was 27.6 ± 18.8 min, and the mean docking time was 12 ± 4 min. None of the patients received blood transfusion. Utility incision was made in only one patient. Postoperative ptosis was detected in two patients with tumors where located in the apical region, and no mortality occurred.

CONCLUSION: Due to the advantages of robotic surgery to the surgeon, patients with schwannoma in extreme locations that would pose challenges in dissection could be operated with da Vinci system.

Keywords:

Posterior mediastinum, robotic surgery, schwannoma

Introduction

Neurogenic tumors located in the posterior mediastinum are paravertebral masses that often originate from the thoracic nerve roots, sympathetic truncus, or intercostal nerves. In a study conducted by Teixira *et al.*, neurogenic tumors were reported to account for 23.6% of all mediastinal tumors.[1] Approximately 95% of neurogenic tumors located in the posterior mediastinum are schwannomas, a benign tumor of the nerve sheath.[2]

Surgical techniques and resection types vary due to reasons such as proximity of mediastinal masses to large veins and nerves, grade of tumor extension, and wide variety of tumor pathology; however, thoracotomy is one of the routinely used surgical techniques.[3] Mediastinal masses require complete resection; thus, patients must be carefully selected for minimally invasive surgery.[4] The developments in video-assisted thoracic surgery (VATS) are known to have popularized minimally invasive mediastinal surgery in recent years. With the introduction of the da Vinci robotic surgery system (Intuitive Surgical, Inc., Mountain View, California, USA) in thoracic surgery, it can be considered

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as an additional option in minimally invasive thoracic surgery. It was reported that the use of the robotic system, which acquires 10 times larger and three-dimensional view and uses robotic arms that have the ability to move in seven planes, provides advantages to the surgeon during dissection of masses and cysts localized in narrow spaces such as the mediastinum in which neurovascular structures are closely packed together.[5]

The present study presents our surgical outcomes and technical details of patients with schwannoma located in the posterior mediastinum who underwent surgery using the da Vinci robotic system.

Figure 1: Computed tomography image of a schwannoma located in the posterior mediastinum

Materials and Methods

In the scope of our robotic surgery program, mediastinal surgery was accomplished in 26 (8.7%) out of 296 patients using the da Vinci robotic system between October 2011 and June 2017. Five (19.2%) patients who underwent surgery of a benign schwannoma were included in this study. Prospectively, collected data of these patients were retrospectively examined. Age, gender, docking and console times, length of hospital stay, anatomic localizations of lesions, pathology reports, blood transfusion requirement, rates of conversion to open surgery, tumor sizes, and mortality and morbidity rates of all patients were recorded. The docking time is calculated as the time between the first skin incision and the beginning of the use of the robotic arm from the console, and the console time is calculated as the time from when a surgeon starts using the robotic arms to the time when the surgeon leaves the console. The recurrence and survival data of the patients were also included in their records by performing face-to-face interview or contacting through telephone.

During the preoperative evaluation, all patients underwent multislice thoracic computed tomography (CT) [Figure 1] at most 15 days preoperatively, and electrocardiography, basic blood tests, and respiratory function tests were performed. Thoracic magnetic resonance imaging [Figure 2] was performed in patients with suspected vertebral, heart, and large vein invasion and in those in whom cystic or solid distinction could not be made, whereas all patients with a solid lesion underwent positron emission tomography–CT (PET/CT). Patients with a standard uptake value >2.5 on PET/CT underwent transthoracic needle biopsy as a diagnostic invasive intervention before admission to our clinic. Only one patient underwent preoperative diagnostic invasive procedure for this reason. The patients underwent follow-up physical examination and thoracic CT every 6 months in the first 2 years and then once every year after that.

Operative technique

After single-lung ventilation was provided with a double-lumen endobronchial tube placed with the help of a fiber-optic bronchoscope under general anesthesia, heart rate, arterial blood pressure, and oxygen saturation of the patients were monitored. Following the planning of one surgeon at the surgical table and one surgeon at the console, the patient was brought to the lateral decubitus position slightly tilted anteriorly. The surgical table was repositioned at 30° to the perpendicular axis of the room and was stabilized. After the camera port was placed through the 8th intercostal space (ICS) in the posterior axillary line, other arms were placed with 30° up camera help. One arm was placed from the anterior axillary line in the 5th ICS, and the other arm was inserted 5–6 cm behind the posterior axillary line in the 8th intercostal artery. By this way, at least 7 cm between each arms could be obtained [Figure 3] and robot docked posteriorly [Figure 4]. The working area was expanded with CO_2 insufflations at a pressure of 6 mmHg and a flow rate of 6 L/min. Prograsper forceps (Intuitive Inc., Sunnyvale, CA, USA) were preferred in the robotic left arm, and a Maryland dissector (Intuitive Inc., Sunnyvale, CA, USA) was preferred in the robotic right arm. After visualizing the lesion, parietal pleura was opened at approximately 1 cm away from the lesion with the help of the Maryland dissector [Figure 5]. The mass was released *en bloc* from the surrounding tissues without disintegration and was ligated using a nonabsorbable polymer ligating clip (Hem-o-lok®) after exposing its origin at the nerve root. After completely excising the lesion, the specimen was brought out from the anterior port incision, if necessary by enlarging the incision, with the help of an Endobag (Endo Catch™ specimen pouch 15 mm, Covidien Mansfield, MA, USA).

After performing intercostal blockage with 10–15 mg bupivacaine hydrochloride (Marcaine) infiltration at all levels, a 28-F chest tube was placed into the thoracic cavity through the anterior port incision for drainage, and the surgery was completed. The patients were

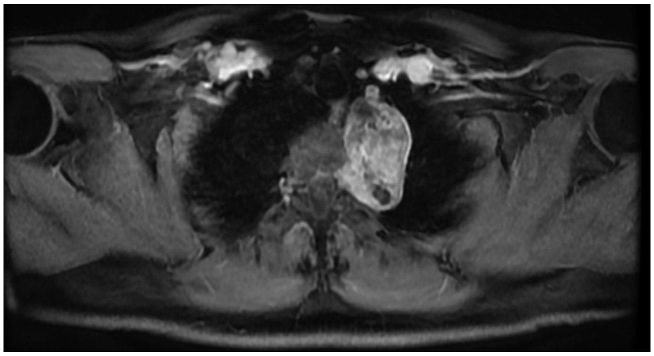

Figure 2: Magnetic resonance image of a schwannoma located in the posterior mediastinum

Figure 4: View of the robot after docking on the patient

extubated in the operating theater and then transferred to the recovery room.

Findings

All patients were male. The mean age was 43.2 ± 12.1 years. Table 1 shows the data of the five patients. An auxiliary incision was made in one patient, completely robotic surgery without an auxiliary incision was performed in four patients, and none of the patients required conversion to open surgery. The console time was ≤30 min except in one patient, and the mean console time was 27.6 ± 18.8 min. The mean docking time was 12 ± 4 min. The mean length of hospital stay was 3 ± 0.9 days. The largest tumor diameter was 70 mm and the smallest was 18 mm. The largest tumor diameter was more than 6 cm in two patients. The tumors in two patients were apically located at the first and the second thoracic vertebral levels. The mean duration of follow-up was 28.4 ± 5.4 months, and no recurrence was observed in any of the patients. Blood transfusion was not performed in any of the patients. Ptosis was detected in two patients with tumors where located in the apical region, and these patients did not show recovery during a 6–9-month follow-up period. No mortality occurred in any of the patients.

Figure 3: Localization of robot ports

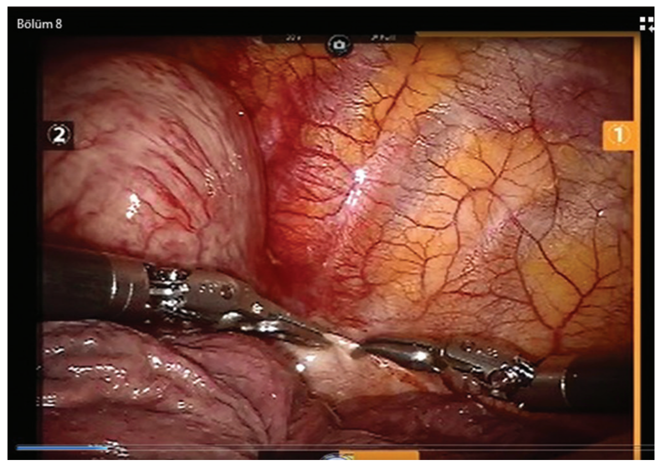

Figure 5: View of opening of the pleura 1 cm away from the lesion from the robot's camera

Discussion

The first report on the use of thoracoscopic resection in mediastinal lesions was published by Sugarbaker and Coosemans in 1993, whereas the first robotic use was published by Yoshino *et al*. in 2002.[6,7] Minimally invasive procedures have become acceptable approaches for mediastinal masses in the last 20 years.[8] Robotic technology has been integrated to video thoracoscopic surgery to use the advantages of VATS, such as shorter length of hospital stay, better cosmetic outcomes, and less pain compared with open surgery, while overcoming the limitations of VATS, such as the use of hand-assisted devices allowing only linear movements and two-dimensional image acquisition.[9] With the advantages offered by robotic surgery, complete resection of the lesions is possible in patients with a schwannoma located in the posterior mediastinum requiring complete resection.

Mediastinal masses are most often located in proximity to vital organs such as the trachea, esophagus, and

Table 1: General characteristics of patients

Complaint	Age (years)	Gender	Tumor size (mm)	Console time (min)	Docking time (min)	Complications	Length of hospital stay (days)	Tumor location	Open surgery indication
Back pain	32	Male	70×50×50	30	10	None	3	T1-T6	Tumor size >6 cm
Ptosis	33	Male	30×25×25	15	10	None	2	T1-T2	Neighboring satellite ganglion
Cough	35	Male	25×20×20	10	10	None	2	T8-T9	None
None	58	Male	32×30×30	20	10	Ptosis	4	T1-T2	Apical location
Back pain	58	Male	60×40×30	63	20	Ptosis	4	C7-T2	Neighboring subclavian artery

Figure 6: Computed tomography image of the apically located lesion

aorta; thus, even though thoracic surgery is a less invasive procedure than open surgery, narrow spaces in the mediastinum may pose challenges to the dissection of mediastinal masses. Routine surgical approach to mediastinal masses involves excision with open surgical procedures.[3] In recent years, however, studies supporting excision of mediastinal masses with minimally invasive procedures have appeared in the literature.[10] With the use of robotic technology that was introduced to our clinic in 2011, 296 patients have undergone thoracic surgery since then, and 8.7% of these patients had mediastinal pathologies. In our previous studies using robotic technology, we reported technical advantages of this new minimally invasive surgical procedure by analyzing the outcomes after anatomic lung resection in patients aged ≥80 years and the outcomes of patients who underwent surgery because of a bronchogenic cyst.[11,12] With its superior characteristics in terms of oncologic outcomes and access to neurovascular structures in narrow spaces such as mediastinum, robotic surgery may allow safer dissection than thoracoscopy, which allows only two-dimensional and linear movements.[13] In this regard, conditions wherein VATS is contraindicated have been clearly described. It is, however, not well known whether robotic surgery has precedence in this regard.

Neurogenic tumors are the most common lesions occurring in the posterior mediastinum, and these tumors are usually asymptomatic and are incidentally detected. They are generally located in the costovertebral area and often arise from intercostal nerves or sympathetic chain. The use of bipolar cautery is recommended in dissection of lesions located in the superior sulcus

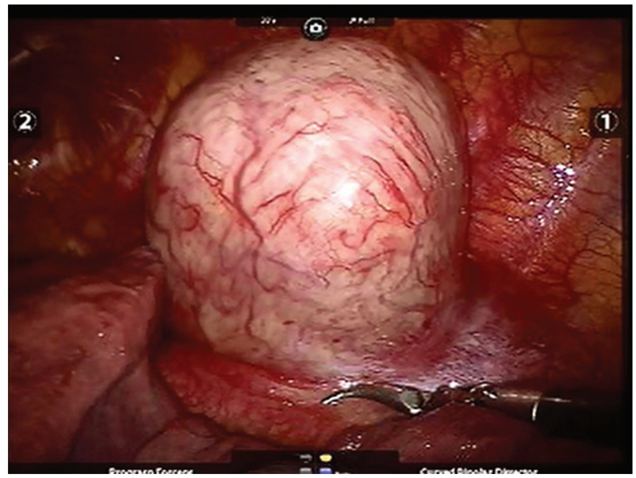

Figure 7: Lesion >6 cm, view from robot camera

because lesions in this area may be in proximity to the stellate ganglion. For this reason, robotic technology can provide a surgeon with the opportunity of performing safer dissection of the lesions located in such areas.[14] In the study published by Nakamura in 2014, the use of robotic technology in resection of posterior mediastinal masses did not necessitate conversion to open surgery, and no complications were reported.[15] In our study, none of the patients required conversion to open surgery, while only two patients developed ptosis. The lesions were apically located in these patients and were in proximity to the subclavian vein and satellite ganglion [Figure 6].

Both VATS and robotic surgery are used in our clinic as minimally invasive surgical procedures. Considering additional costs associated with the use of robotic surgery compared with VATS, we recommend detection of lesions wherein the advantages of robotic surgery surpass the disadvantages, and robotic technology could be preferred particularly in such cases.

Conclusion

Owing to technical advantages offered by robotic technology in mediastinal surgery, we suggest that robotic technology could be preferred in patients that would pose challenges in dissection in which open surgery is mostly recommended; these are with a history of thoracic surgery, with schwannoma located at the apical region (in proximity to great vessels and intervertebral foramina), and patients with tumors >6 cm [Figure 7].

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Conflicts of interest
There are no conflicts of interest.

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