Robotic-assisted right middle lobectomy

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Abstract: *Da Vinci* surgical system has been widely used in thoracic surgery as a new technique. We are going to share the experience of robotic surgery for right middle lobectomy. A 48-year-old patient with a ground-glass opacity (GGO) underwent robotic-assisted right middle lobectomy in our center. The patient was discharged on postoperative day 4 without any perioperative complications. The pathological stage was T1aN0M0 (stage IA).

Keywords: Robot-assisted surgery; lung cancer; minimally invasive; lobectomy

Clinical data

Medical history

A ground-glass opacity (GGO) was detected in the medial segment of the right middle lung lobe of a 48-year-old man about one year ago during a regular medical examination. He did not have any symptoms (e.g., chest tightness, shortness of breath, cough, or expectoration) at that time; therefore, we suggested he undergo regular re-examinations. Result of a computed-tomography (CT) scan one month ago still indicated a 0.9-cm GGO in the same position. The patient still had no symptoms. Positron emission tomography-CT showed hypermetabolism in this nodule. The patient's physical performance was good, and his appetite, sleep, urination, and defecation were normal. His body weight did not change significantly. He denied smoking or alcohol abuse, and family history.

Physical examination

A complete physical examination was performed when the patient was admitted. No abnormity was found. No lymph nodes were palpable in the neck, axilla, or below the clavicle.

Auxiliary examination

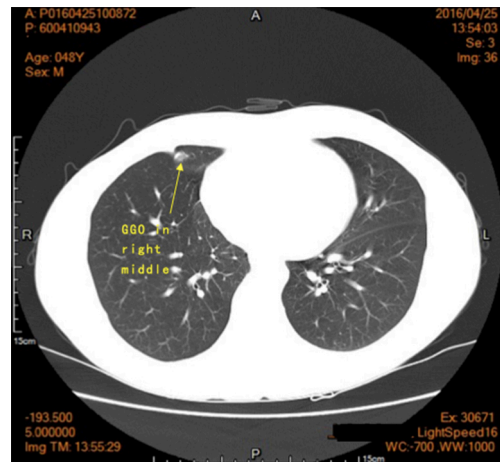Chest CT showed a 1.1-cm elliptic GGO in the right

Figure 1 The GGO was located in the right middle lung lobe. GGO, ground-glass opacity.

middle lung lobe, with clear margins, without lobulation sign, spiculation or vacuole sign (*Figure 1*). No abnormity was found in the lung hila. No abnormal lymph nodes were found in the mediastinum.

PET/CT showed hypermetabolism in the nodule of the right middle lung lobe.

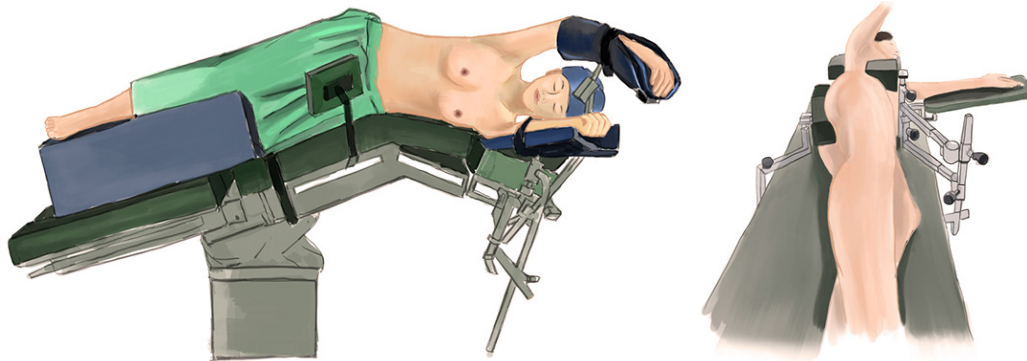Abdominal ultrasound scan, bone scan, cranial magnetic resonance imaging, echocardiogram, and pulmonary

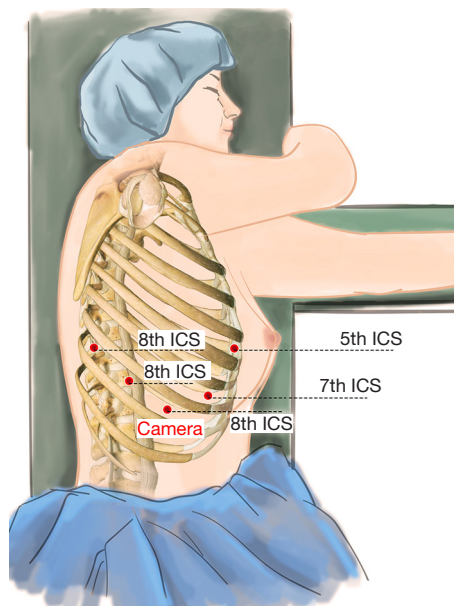**Figure 2** Jackknife position.

Figure 3 Ports in the 5th, 7th, and 8th ICS. ICS, intercostal space.

function were normal. In addition, blood routine test, hepatorenal function, and blood gases were normal.

Pre-operative preparation

The results of imaging, including PET/CT, suggested that the GGO was considered to be malignant. The lesion was in medial segment of the right middle lung lobe, near the hilum; therefore, segmentectomy and wedge resection were not suitable. After the preoperative discussion and agreement of the patient, we decided to perform robotic-assisted right middle lobectomy.

The patient was a middle-aged man in generally good

condition, without chronic disease, smoking or alcohol abuse, so the preoperative preparation was quite simple. During preoperative education, we described his condition and the surgical method, as well as situations that may occur after surgery. We told him to practice elimination while in bed. We taught him pulmonary function training and how to cough and expectorate after surgery. Eating and drinking are routinely forbidden after 9 pm the day before the operation.

Surgical procedures

Anesthesia and body position

The patient was first placed in the supine position. After combined intravenous and inhalation anesthesia, the patient was placed in a right lateral decubitus position under double-lumen endotracheal intubation, with his hands in front of his head. Then he was placed in the jackknife position and provided with single-lung (left) ventilation. After the patient was fixed tightly, the operation table was turned about 20° towards the patient's back (*Figure 2*).

Incisions

A 12-mm camera trocar was placed in the 8th intercostal space (ICS) at the right mid axillary line, three 8-mm working trocars were placed separately in the 5th ICS at the right anterior axillary line (#1 arm), 8th ICS at the right posterior axillary line (#2 arm), and the right 8th ICS (#3 arm), 2 cm from the spine. A 12-mm auxiliary incision was made in the 7th ICS at the right posterior axillary line (*Figure 3*). Then we created 8–10 mmHg artificial pneumothorax using CO_2. The patient-side cart was connected over the patient's
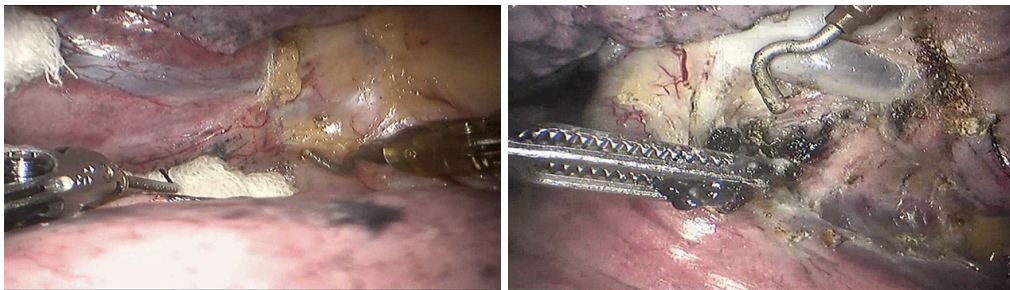
Figure 4 The mediastinal pleura was opened behind the phrenic nerve, exposing the hilum of the right lung. The hilar lymph nodes (No. 10) were removed.
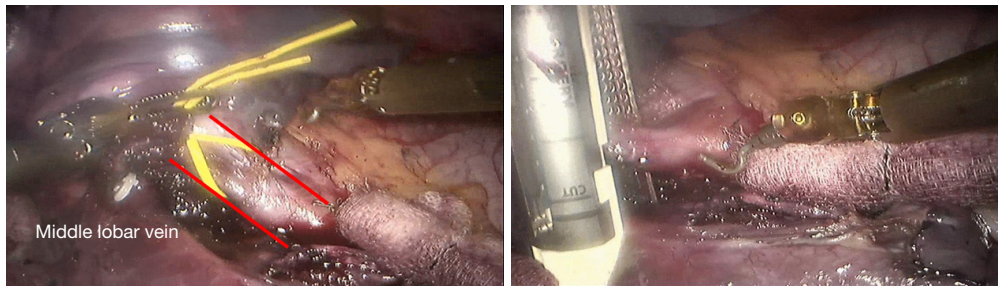

Middle lobar vein

Figure 5 The superior pulmonary vein and middle lobe vein were dissected. The assistant pulled the middle lobe through an auxiliary incision to expose the middle lobe vein. It is important to find all its branches. Then the elastic cord was used to pull the middle lobe vein. The Endo GIA™ 60 mm was used to transect the vein with a white reload.
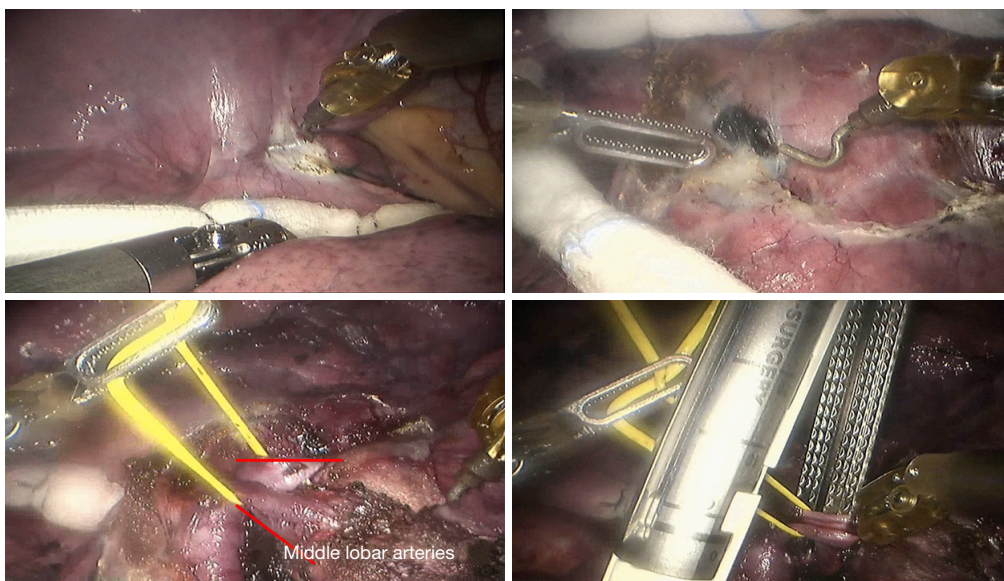

Middle lobar arteries

Figure 6 The initial part of the horizontal fissure was opened, and the interlobular lymph nodes (No. 11) were removed. The lateral segmental artery and medial segmental artery were dissociated and transected with a white reload.

head. The #1 arm (right hand) was connected to permanent cautery hook, and the #2 arm (left hand) was connected to fenestrated bipolar forceps.
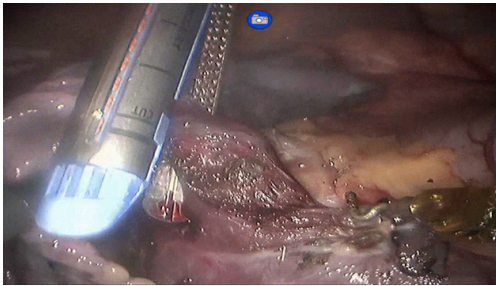
Procedures

See *Figures 4-12*.

Figure 7 The middle lobe bronchus was dissociated transected it with a blue reload.

Finally, the thoracic cavity was washed with warm water, and the right lung was ventilated. No air leakage or bleeding was observed. We placed an indwelling 28# thoracic drainage tube and a thoracic micro-tube at 8th ICS and 9th ICS, respectively. Then all incisions were closed.

Postoperative treatment

Postoperative treatment is similar to that given after video-assisted lobectomy. No complication was observed. The
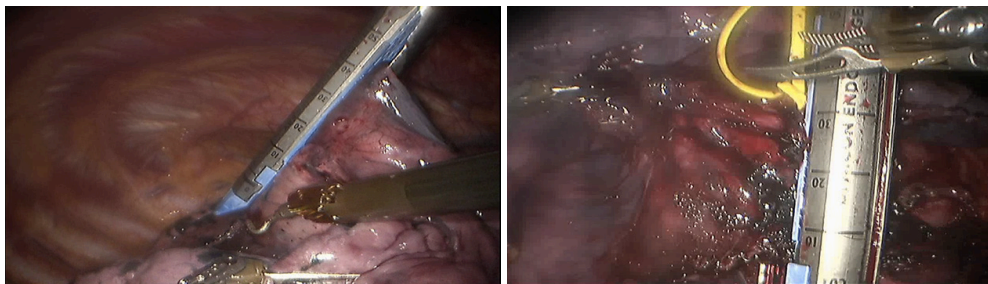

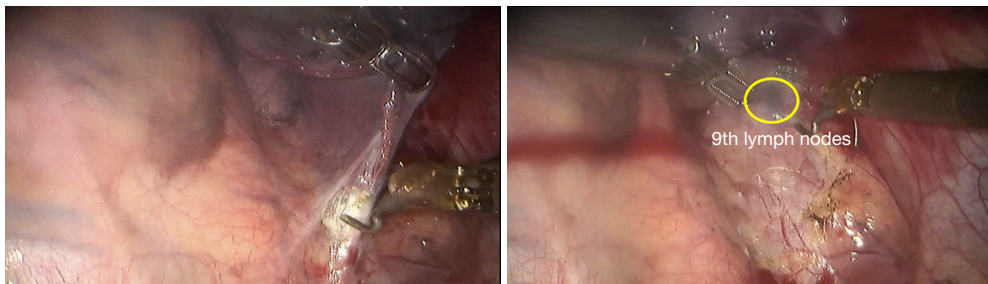**Figure 8** The remaining horizontal fissure and oblique fissure were cut with two blue reloads.

Figure 9 The inferior pulmonary ligament was divided to the inferior lung vein level, and the nearby lymph nodes (No. 9) were removed.
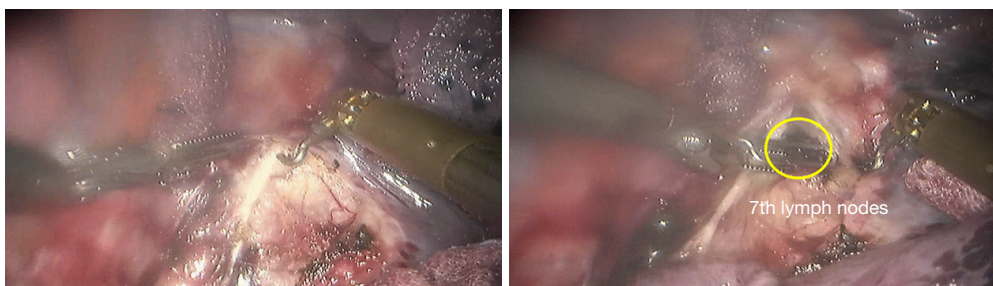

Figure 10 The posterior mediastinal pleura was opened to remove the subcarinal lymph nodes (No. 7).
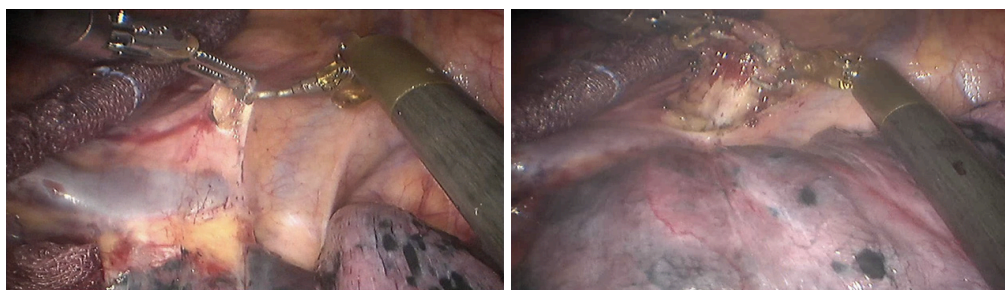
Figure 11 The upper mediastinal pleura was opened to remove lymph nodes near the trachea (No. 2 and 4), azygos vein arch and the superior vena cava.
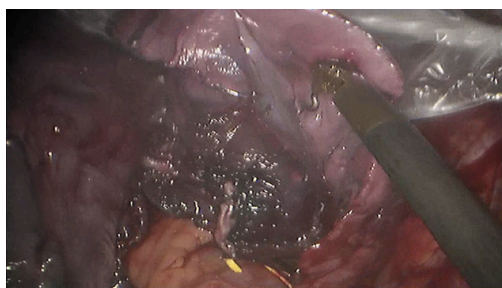

Figure 12 After extending the auxiliary incision to about 4 cm, we removed the resected middle lobe using a specimen bag. A lung cancer, diagnosis was proved by frozen section diagnosis. Bleeding was limited during surgery.

patient ate and took part in out-of-bed activities on the first day after surgery, and was discharged on the fourth day after surgery, with the thoracic drainage tube withdrawn. The thoracic micro-tube was withdrawn on 14th day after surgery.

Pathologic diagnosis was lung adenocarcinoma *in situ* (1 cm × 0.5 cm × 0.5 cm) with focal micro-invasion. No cancer cells were detected at the bronchial stump or lymph nodes.

Discussion

Because of the aplasia of fissures and the adhesion of lymph nodes around the vessels and bronchus, right middle lobectomy can be difficult (1). The stability and dexterity of the *da Vinci* Surgical System make it suitable for this procedure (2). Especially in systematic lymphadenectomy (3), the high-resolution three dimensional view makes it easier to completely remove lymph nodes thoroughly with less injury to nearby tissues.

Appropriate body position and incisions are key points of this surgery. We choose the lateral decubitus position and elevated the chest to make the surgical field clearer (4). After several attempts, we choose these incision locations that make it possible for the camera and robotic arms to cover the entire thoracic cavity. The auxiliary incision should be chosen to be convenient for placing instruments, such as the Endo GIA™ and the specimen bag, and to minimize mutual interference between the robotic arms.

Regarding the choice of instruments, we use three arms (5), including a camera lens, a permanent cautery hook and a fenestrated bipolar forceps to meet the need for cutting, dissociation, coagulation, and pickup.

The case was typical, dealing with veins, arteries, bronchus, and fissures successively. However, we should pay attention to potential anatomic variations of these structures. In addition, the assistant should cooperate well with the surgeon and be experienced in thoracoscopic surgery and thoracotomy. In emergency circumstances, such as rupture of the main vessels, the assistant should be able to handle the situation independently under thoracoscopy or even open the chest immediately.

Acknowledgements

Footnote

Conflicts of Interest: The authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/amj.2017.01.07). 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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